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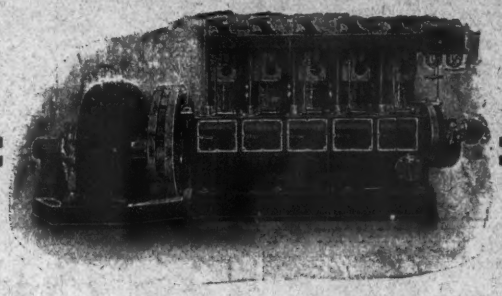

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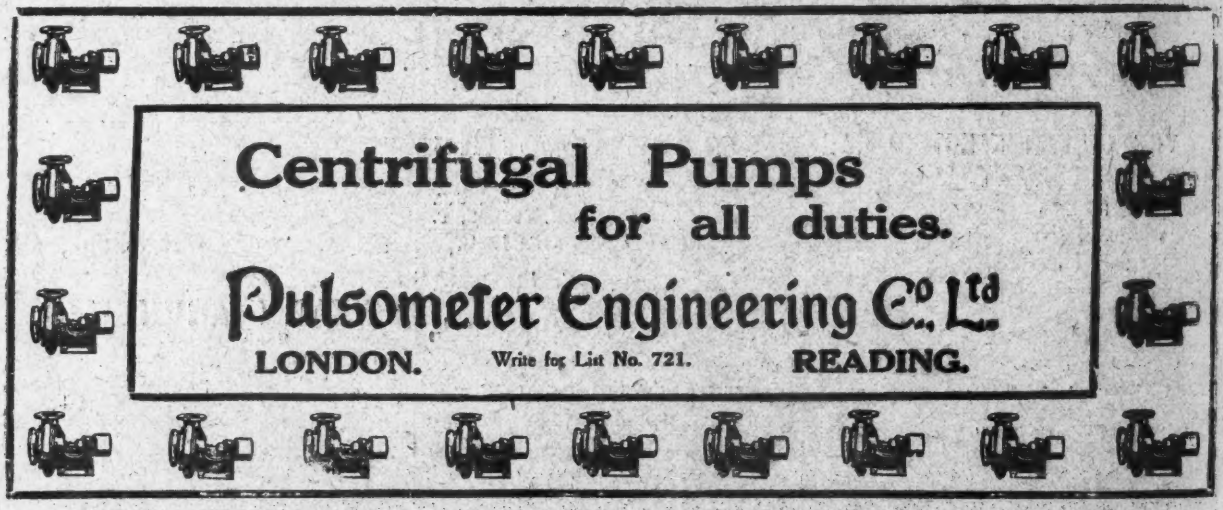

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THE

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GOVERNMENT ASSISTANCE FOR OUR FOREIGN TRADE.

IT will be remembered that the late Prime Minister appointed a Sub-Committee of the Cabinet to consider the question of reconstruction after the war. The changes in the Cabinet, we suppose, necessarily involve a change of *personnel* in that Sub-Committee, and though the membership of the House of Commons has not materially altered, it is safe to assume that the conclusions arrived at by those who advise Parliament concerning reconstruction policy, will not now be the same as they would have been if the Lloyd-George spirit had been suppressed. It is universally understood that the present Cabinet has been formed for the purpose of bringing the war to a victorious end with the utmost expedition, but while its members are bound to be very busily occupied with their individual tasks, they will not be able to leave Reconstruction measures out of account; indeed, the announcement of a great Empire Conference to be held in February is a proof of their desire to deal promptly with such subjects. There are more business and industrial men in the Government than we have ever had before, and they will not be in the mood for wasting time in academic discussions. Furthermore, they have in a number of cases already expressed views on trade policy which will cling to them, and, to put it mildly, those views are not less advanced than were those of either Mr. Asquith or Mr. Runciman. The Sub-Committees that have been, and in some cases still are, sitting, will send up their considered reports as to what measures should, or should not, be taken in order to safeguard our industries after the war, and the conclusions of the Paris Economic Conference will, together with these, ultimately settle what certain aspects of our Empire and inter-Allied trade relations will be, while such matters are almost certain to find a place in whatever "terms" are eventually made with the enemy. To our mind, however, none of these matters need interfere with, or be affected by, measures that require to be taken for securing long-needed and long-called-for measures of reorganisation of the machinery available in certain Departments of the Government for the promotion of British trade in foreign countries. Therefore, we do not consider it premature to urge upon the attention of the Government the recommendations, to which we only briefly alluded last week, of the Federation of British Industries.

The Federation lays it down, and everybody in trade or industry must surely agree with it, that after-the-war conditions will render it a vital necessity for British productions to secure a greatly increased sale in foreign markets in order to assist us in carrying the financial burdens which may be ours for years to come. In all probability that necessity will exist for Allied and Enemy countries alike, though not to the same extent in all cases. It is reasonable, therefore, to anticipate increased severity of competition in some markets, though we shall be able to rely upon larger trading relations with our own Colonies and dependencies and with some of our Allies. Reorganisation leading to greater governmental sympathy with, or encouragement of, foreign trade has been called for for many years. The demand has expressed the common sentiment of business men, but the revelations and consequences of the war have brought it nearer to practical realisation. All drastic change is not necessarily good, but

this is one of the alterations which seems to us to call for expeditious handling. The mere criticism of Government Departments, the mere demand for a general change, or the supposition that some new Ministerial appointment or other will solve our problems, are only of use up to a certain point. They have sometimes drawn the question: "What, then, do you suggest that we should do that we are not doing already?" That is the official attitude as we have sometimes met it, and if propositions have been proffered, there have been some departmental or political obstacles standing in the way of reform. Now, however, with an altered national attitude toward, and anxiety for, trade, and with a disposition of the nation to look to Whitehall and Downing Street for industrial encouragement, the atmosphere is a suitable one in which to consider detailed proposals; and this being so, the scheme elaborated by the Federation of British Industries, and the recommendations of the Special Committee of the Executive Council of the Association of Chambers of Commerce, have made a most timely appearance. The Federation suggests certain broad principles which are considered essential to any successful reorganisation of Governmental Commercial Service. Separation and overlapping have been weaknesses which have stared most of us in the face, and have explained some past inefficiences. Therefore it seems right to suggest that there should be concentration of control in a single department. The situation requires "a large scale organisation" under "active, vigorous, and homogeneous central control," and the Federation favours no measures for tinkering with detailed reforms of existing organisations, but a "fundamental reconstruction of the present administration." But however large an organisation, and however homogeneous, it will not give the desired efficient service unless it be in the closest possible touch with the industrial and commercial community. We have emphasised this point again and again in our pages, urging that those who go abroad to officially represent our national trade interests should be afforded the amplest possible facilities for steeping themselves in our industries and commerce by practical contact with them in suitable districts before they go. In a number of cases in recent years this practice has been followed, but the official whose days are all spent in Civil Service office life will be one of the first to admit that he is at a loss when he is met by the eager, live representative of some industry or other. In short, there is all the difference in the world between passing on in official document form some piece or other of information received from a correspondent, and affording valuable material as the result of a practical first-hand acquaintance with the actual parts of an industry itself. The more closely a new Department comes into touch with real manufacturing activity the more likely it is to be able to understand our national abilities, and to practically meet the needs of the manufacturer in respect of information or other assistance. The point is so obvious, yet it is none the less important, because the obvious seems to have been too long inadequately appreciated.

The Federation holds that foreign commercial policy can only be successfully conducted as an integral and important part of general foreign policy, and that the Department charged with commercial duties should be the Department in general charge of Foreign Affairs. There are such questions as railway, loan, dock, and similar projects, and schemes for the development of foreign natural resources, likely to assume a large place in our affairs in the future, and these and all cognate matters should come under one Department of the Foreign Office. No divided control, no dual element, will do.

The Federation considers that the Foreign Office should be responsible for the protection and promotion of all British industrial, commercial, and financial interests and activities in foreign countries, and for the collection and distribution of all information on matters connected with industry, commerce, or finance in those countries. Prompt and vigorous support of all efforts to secure contracts, concessions, or orders in such countries would be called for, and in these days of sacrifice the Federation recognises that this support may sometimes "entail the selection of one of several British competitors." The Foreign Office may here be inclined to advise our firms to co-operate in these matters, instead of competing—have we not lost too many good contracts in foreign fields in the past because we have competed against each other the while the amalgamated foreigner has appropriated the spoils? It is also urged that only *bona fide* British firms should be accorded such support. "It should be refused to all firms, whether technically British or not, which are in any degree under foreign influence." This is excellent in spirit, but the Foreign Office Department will have to be very much alive, and will have to be furnished with very different records from those, if any, which existed in Government offices concerning either wholly or partly-owned companies before the war. In war time much valuable information of this character has been got together, more requires compiling, and the black lists of war time will need constant revision, or there may be difficulties in ensuring that only the purely British trader is supported. But difficulties or no difficulties, our factories will call for orders and our workers for employment; that fact must dictate our policy and the course of our departmental activities. The Federation suggests that there be left to the Commercial Department of the Board of Trade, to a Ministry of Commerce, or some other Department, the necessary organisation and control of industrial and commercial activity at Home, and the collection of commercial intelligence respecting the Dominions and the Crown Colonies, but that the work of such Department, and of the proposed new Foreign Office Department, should be co-ordinated, and that there should be free and full consultation between them. Presumably it is regarded as impracticable to concentrate foreign and colonial commercial matters in one Department. Short of that, there certainly will require to be efficient co-ordination and co-operation.

Of course, all these and other re-arrangements will involve large increases in national expenditure, but we have always advocated the generous policy in such matters, believing that the return will amply justify it. We need hardly follow the document through all its propositions respecting the extra staff and accommodation required, the need for the staff to frequently visit industrial centres, and to accord intelligent interviews to all British subjects desiring to discuss foreign trade questions; the appointment of representative Committees of Trades; the raising of rank of Commercial Attachés; the appointment of Commercial Counsellors (we dislike the term) attached to every Embassy and Legation; and the condition of appointment, promotion and training of all the officials. The spirit running through most of these and other parts of the document is to demand that men of suitable training and experience should be employed wherever it is necessary to render British traders assistance in the foreign markets, and that their status should be worthy of the importance of their calling, which is to ensure ample and prosperous activity for British factories and for British workpeople.

We cannot pass without special reference the concluding proposal, namely, that relating to the provision of a staff of experts. It is shown that as the knowledge and experience of the officers of the regular services must be general in character, it will become necessary to provide means for securing detailed and expert reports on particular trades, industries and markets. We have repeatedly urged the importance of this, and have noted in our conversation with Government officials how greatly they are at a disadvantage, because they are unable to discuss our own, or any one particular industry, with a really intimate knowledge. Save in quite exceptional cases the replies to our requests for information on the electrical trade situation have been so vague as to be of little practical value. Yet the officials themselves can hardly be blamed, for we recognise that "their regular services," as things now stand, must inevitably "be general in character." The Federation recommends that a large number of commercial and technical experts should be selected and employed on temporary missions, as and when required, to investigate and report upon industrial or commercial conditions or opportunities in particular markets and particular countries. These are so much like our own words that we need not say how heartily we endorse them.

We join with the Federation in strongly urging upon the Government the vital importance of taking immediate

steps to reorganise the present services, so as to be as ready as possible for future events; there are things left undone that ought to be done, and there is overlapping which ought to be avoided.

Whether or not the Federation scheme, either in part or in entirety, is adopted by the Government, it certainly forms an excellent basis for both discussion and action, and the organisation deserves the thanks of British industry generally for the full and serious attention that it has devoted to the matter.

The Wire-Drawing Industries.

The question of German competition in the wire-drawing industries has received, and is still receiving, the careful attention its importance merits from the responsible heads of the leading British firms. Doubtless the question of American competition after the war, which is becoming one of increasing importance is also receiving the proper attention it deserves. The statistics just received from the Board of Trade of American exports of fully-manufactured copper wire, strip, &c., exhibit, as they were expected to do, a heavy increase on pre-war figures. The fact that the war has thus benefited American wire manufacturers in some measure at the expense of British firms, is a circumstance inevitably arising from the exigencies of the situation, but the German wire manufacturing firms must have suffered, as regards their hitherto prosperous export trade, in a still more marked degree. The positions acquired by the American firms is now more than ever one of great strength, and the competition between British and American firms after the war is likely to be conducted on very keen lines. On the other hand, the position of British firms is, we believe, one of great strength, and the war has opened out for the immediate future fresh channels of trade for the home firms hitherto almost entirely monopolised by foreign manufacturers. With increased inter-organisation, and a still closer co-operation of principles of mutual trade propaganda interests among the leading British wire manufacturers, the position for the future may be regarded with confidence.

Accounts and Discounts.

In our issue of March 3rd last, a central station engineer of a reforming disposition drew attention to the extraordinary methods adopted by some manufacturers in rendering their accounts, successive discounts such as 20, 10, 5, and 5 per cent. being deducted from the list prices, while in some cases, after several discounts had been deducted, 5 per cent. would be added to the amount on account of an advance in prices. It would seem that no business man would permit such a system to obtain in his counting-house without very good reasons indeed, and the practice is so common, that there must be some such excuse for its continuance; even firms of the highest standing make use of the system freely, and we have before us a recent example of this kind, in which, moreover, almost every item has both positive and negative discounts appended. One might think that "25 per cent. plus 5 per cent." meant 30 per cent., but it does not; neither does it mean 20 per cent. In the worst cases there are four arithmetical operations—three deductions and one addition—to be carried out without even the aid of decimal coinage. Now, despite the argument that there surely must be good reasons for these manipulations, we know that they are not indispensable, for on March 31st we were able to state that Messrs. Henley had issued a price list showing net prices without any calculations at all. Again we commend this excellent example to the notice of all manufacturers, in the hope that by following it they will eliminate no small amount of wasted labour, and thus help to win the war.

ELECTRICAL SIGNS OF THE TIMES.

[COMMUNICATED.]

In these dark days and darker nights, those of us who are interested in electrically-illuminated signs can only possess our souls in patience and wait for better times. A glance, however, through the American technical Press will do something to raise our spirits; for there we can read, with something approaching envy, of the progress of the electrical sign movement in a country where lighting restrictions, or, for the matter of that, any other restrictions, appear to be unknown.

It is permissible to wonder whether the present universal upheaval will bring about a renaissance of public spirit in England, and whether our cities, towns, and villages will develop that spirit of municipal emulation which, judging from what one reads, is common in America. Will any English town or city be as bold as so many American cities have been, where they use electrical signs to prove that they are more progressive than their neighbours? and also, so that no traveller shall be in any doubt in identifying one town from another, even if he pass through it by night. There are dozens of towns in the United States which vie with each other in displaying mighty electric signs blazoning forth the names of the towns, with appropriate mottoes, and with all the ingenious flashing devices which the trade can supply.

These town mottoes, or "slogans" as they are called, are apparently selected by means of local competitions, and when one reads the winning slogan one wonders, at times, what the "also rans" were like. For instance, we read that the city of Wausau, Wis., has recently dedicated an electrically illuminated sign 40 ft. × 38 ft., lighted by 976 lamps, reading "Work for Wausau." All the inhabitants of the city turned out to the dedication; there were processions, bands and speeches, and doubtless a great trade in ginger beer and ginger bread upon the side walks, for one feels somehow that so progressive a city must be in a prohibition belt. The flashing device is thus lucidly described:—"First the eagle and ribbons come on, followed by the torches, which are followed at an interval of 15 sec. by the wording, then all out, all on at once, all out, and repeat as before." It reads rather like instructions to knit soldiers' socks, but is doubtless very effective.

The city of Pottsville, Pa., is apparently not so important a place as Wausau, Wis., as its sign is only 20 ft. × 20 ft. The slogan is the inspiring one—"Pottsville, the Best Site on the Anthracite." One feels that the inventor of this motto has a genius for rhyme and rhythm, which is destined for a larger field than Pottsville.

Elyria, O., was, perhaps, more fortunate in its slogan, and certainly more ambitious in its sign, for it is 50 ft. × 36 ft. The lamps are in five colours, and it is wired for "scintillating effect." The slogan in this case is "Elyria, the 100 per cent. city," which cryptic words rather leave one wondering, not only what they mean, but what the other suggestions in the competition were like.

Goldsmith's "Deserted Village," had it but had the modern advantages of Wausau, Wis., Pottsville, Pa., or Elyria, O., might have been deserted no longer, and so have increased its sphere of usefulness.

This municipal slogan sign business is not the only case in which the American electric sign manufacturer has an advantage over the English one. Even the churches out there do not object to draw public attention to themselves through the medium of the electric sign. Trinity Church, Cincinnati, O., has an "enormous electric sign in the shape of a cross, 18 ft. × 8 ft., hung 12 ft. above the sidewalk." There are 250 lamps upon it, and in 16 in. illuminated white letters on a blue background are spelt the words, "Trinity Church." "The completion of the sign was made the occasion of impressive dedication ceremonies, attended by special music, and presided over by high church dignitaries, including several bishops. The sign is lighted every night."

There are many people in England who maintain that the Church has fallen behind in its work, and that it requires rejuvenation. Doubtless the electrical sign manufacturers will be willing to take their share in the great awakening

when it comes ; it is possible that, as usual, we shall be too late, for as an electrical means of publicity the illuminated sign, with its quantity of small lamps and ingenious and complicated flashing devices, is not alone in the field. In America it is, in fact, just a little passé. The present rage is for "flood lighting" ; powerful lamps, more or less concealed, are by reflectors made to project a great flood of light on to the selected building, which thus stands out shining from its neighbours. The tower of the Woolworth building in New York is illuminated by the light from 600 1,000-c.p. lamps, each mounted in a projector and fixed upon adjacent buildings.

Hundreds of municipal buildings up and down America are lighted in this way. Shall we, when the reaction from our present lighting restrictions sets in, squander the electricity we have saved by flood-lighting St. Paul's Cathedral or the Bank of England ? The effect would be somewhat startling to our insular ideas. There are people who suggest that many of our public institutions would be the better for more light upon them, but probably they are not thinking of the same thing.

One can conceive that English public taste might have some restraining effect upon the kind of building to which flood-lighting would be applied. For instance, we in England would probably consider that a public mortuary might be left in as much obscurity as possible. Even in these times, few of us are anxious to find our way there, and those within probably desire nothing better than to be left in peace. In the United States they look at these things differently. In a recent number of the *Electrical World* there is an account of the flood-lighting of a mortuary in Denver, Co. It appears that this mortuary is the property of one George Olinger, a Denver undertaker. We are assured that it has long been one of Denver's show places by day, and that Mr. Olinger desired that it might be made equally attractive by night. It seems a quaint notion, but in fairness to the proprietor it should be pointed out that "at the outset he stipulated that the effect must not be garish or circussy" ; one likes the man for that. Apparently several schemes were tried ; the first one failed, "for while the lamps illuminated the building effectively, the glare was objected to by persons coming from the building at night."

One has an idea that the usual inhabitants of a mortuary, suddenly finding themselves able to get out at night, might easily object to the glare from the 56,600 c.p. of electric lamps with which the front of the building was lighted. There seems something ghoulish about the idea to an Englishman, but Mr. Olinger assured the correspondent who describes the installation that it was "the best thing in the way of advertising he had ever undertaken."

From the above examples it will be seen that there are in England vast unexplored fields of usefulness for the electric sign, if only our local authorities will waive some of their out-of-date regulations, and if we will take some lessons from our American cousins.

HIRE AND HIRE-PURCHASE SYSTEMS.

[COMMUNICATED.]

All electricity supply engineers and managers are anxious, so far as may be possible, to extend their sources of revenue, and most of them have given attention already to the important question of placing various current-consuming apparatus on their mains under some form of hiring or hire-purchase arrangement.

Certain authorities have supplied motors under such schemes for many years, whilst other apparatus that has thus furnished an additional and a remunerative income includes ventilating fans, heating and cooking apparatus, and—in pre-air-raid days—arc lamps.

But if much attention has been given to this form of revenue, it must be conceded that there is an immense field yet unexploited, and, in fact, it is not an exaggeration to say that only a beginning has been made in the development of what is possible and probable in this direction.

While it may be argued that the present is not the most propitious time for capital expenditure, should such expenditure be necessary for the inauguration of a scheme, yet now is the time to go into the matter in complete detail, so that with the return once more of normal conditions, everything may be in proper train for the successful initiation or extension of one or other of these systems ; this is particularly the case when it is remembered that very likely the restoration of peace may be accompanied by a scarcity or a tightness of money, than which favourable condition for a successful hiring scheme there is none better.

The writer ventures to suggest, therefore, a few of the important considerations and aspects of the subject to which attention may be usefully drawn.

In the first place, the object of a hiring business being to make money, it will be readily seen that it is essential to introduce some safeguard against loss, due to financial instability of the prospective consumer. It is not always possible to ensure against total loss, nor is it possible here to lay down any rules to govern such a contingency. It must be left to each engineer or manager to devise his own regulations in this matter, and these regulations should obviously be drawn up to suit the various classes of consumer, apparatus, &c., involved. The days are gone by when the word "hire" carried with it something of a stigma or an insinuation that the hirer was not overburdened with capital, and it is fairly common to find that establishments of long and sound standing may prefer to put in quite large factory installation under this arrangement ; it is, of course, entirely a matter of terms and comparisons. The electrical supply authority catering for this class of business is, moreover, at some advantage over the canvasser selling bicycles or sewing machines, in that whilst these may be usefully employed elsewhere by any dishonest "flitter," electrical gear has its sphere of employment limited by voltage considerations, &c. There is the further point that the slow payer may be brought to reason by having his supply cut off. However, as already stated, little can be said upon this aspect beyond emphasising the importance of safeguards.

Then there is the legal question to consider. While certain legal points must be kept in sight, it is extremely easy to exaggerate the importance of others ; the law is always more or less harassing to the layman, and in drawing up a standard form of hiring or hire-purchasing agreement to meet all contingencies, legal aid should be called in, but it is well to see that the lawyer is well chosen, by which I mean that he should be one specialising in commercial work, and both willing and able to pay every regard to simplicity and brevity. These two characteristics are of the greatest value in negotiating business under the agreement with prospective consumers. In most cases an agreement that—

(*a*) Insures against loss by fire, theft, &c.

(*b*) Is applicable to a private individual or to a limited liability company.

(*c*) Prevents distraint upon hired machinery or apparatus for rent or other debt, and at bankruptcy or liquidation.

(*d*) Prohibits removal of hired machinery or apparatus from certain stated premises except by the written consent of the supply authority, and

(*e*) Makes suitable provision for periodical payments,

may be taken as covering the more necessary requirements, but the particular nature of the business done by individual supply authorities will suggest their own agreement requirements. Thus in a number of smaller concerns, certain of the foregoing suggestions may be deemed unnecessary, such as clause (*a*), whilst in the case of a hire-purchase agreement, as distinct from a hiring one, there must be inserted a clause allowing the customer the option of purchase outright at a pre-arranged price and at any period of the agreement. Again, agreements operating under Scottish law must be drafted accordingly. So far as the foregoing suggested clauses are concerned, some notes may not be out of place :—

(*a*) If this clause is used, an arrangement may be made whereby the premiums are paid to the insurance company by the supply authority and refunded by the hirer.

(*b*) and (*c*) Purely a matter of legal draft.

(*d*) In regard to this it is as well to point out that the legal mind variously regards what the layman would term a "fixture" according to the use of screws or nails. It is desirable to affix to all apparatus supplied a nameplate

indicating that it is the property of the supply authority; this namplate to be removed only when a *purchase* is completed.

One of the most necessary steps in the inauguration of a successful scheme is the provision of a showroom electrically lighted, heated, and ventilated.

The suitable locality of the showroom is a problem calling for special consideration of the circumstances attached to the scheme as a whole. Thus, if the business sought be in the nature of fittings, fans, cooking apparatus, fires or other heating apparatus, the showroom could not be placed in a more likely position than in one of the best shopping streets where the feminine shopping community congregate. Obviously, such a position may be totally unsuitable for a power supply authority looking solely to a motor load; in such a case the showroom must appeal to a totally different class of customer—the business man, the engineer and the foreman—and be located accordingly; a suitable position for a showroom of this description may be in the industrial part of the town or in close proximity to a railway station largely frequented by the men it is proposed to attract.

The manager of the showroom must be a man of good address and personality, a capable salesman and a sound commercial engineer, fully conversant with the apparatus he is pushing, and abundantly blessed with tact.

The equipment in the showroom must be kept constantly up to date, and special prominence given to *novelties* for both domestic and industrial application; each piece of apparatus should be neatly and briefly labelled with :—

(*a*) Catalogue number or other reference.
(*b*) Price for hire.
(*c*) Price for hire-purchase.
(*d*) Price for sale outright.
(*e*) Cost price.

Circumstances may not necessitate all this; the cost price must, of course, be coded, and the others may be, if deemed advisable. It is a good scheme to allow the showroom attendants a commission on apparatus sold, upon the lines indicated in recent commercial articles in the ELECTRICAL REVIEW.

Next we may discuss the fixing of the rates for hire or hire-purchase; every attention and care must be devoted to this, bearing in mind that while the rates must in themselves be financially and commercially sound, the real *raison d'être* for the whole scheme is the sale of *electricity*. Again, while the hiring rates must not be so high, that the prospective customer feels he is being "squeezed," yet the "purchase outright" price must be made attractive enough to encourage this class of sale, more especially in the less expensive apparatus, where it is infinitely better to keep the routine and clerical work within the closest limits; for example, it will readily be seen that, if it can be avoided, a flat-iron should not be sold under a hiring system unless, of course, it is but part of a larger and more remunerative sale. This last remark, however, would have to be suitably modified in those districts which afford scope for an organised "campaign" and where, consequently, the "all-in" cost can be correspondingly reduced. Other factors to be considered in fixing rates are costs of repairs, and wiring for new heating circuits, &c., when necessary. In regard to these, actual experience only can enable a manager to give the close estimate necessary, and with special reference to the cost of repairs, this item is necessarily uncertain, depending, as it does, so much upon the class of apparatus, the reliability, or otherwise, of design and workmanship, and the conditions of service. Experience alone is the best guide for the accurate determination of the respective values of the hiring and selling groups, and therefore of the fixing of the respective rates and prices for the two classes of business; altogether it is a matter for nice adjustment.

Having effected a sale, either for cash or by hire, it is well that the manager should realise that the transaction has not ended; quite apart from the question of payment, it can safely be said that it has but begun. The efficient manager always has it in mind that the new consumer must be a "satisfied consumer"; to this end he arranges for periodical inspection and observation of the apparatus, and its behaviour, and for providing the customer with any useful "tips" there may be for satisfactory operation. It is probably well to emphasise that in a hiring business, more so than in any other, it is essential to supply only apparatus by well-established manufacturers of repute, and likely to give a minimum of trouble; this consideration quite independently of the repairs bill.

We now come to a very important point in all hiring systems—viz., the necessity of keeping as accurately as possible the life history of each individual piece of apparatus. This may best be done by means of a suitably-indexed card system. I have already said that it is desirable for all clerical and routine work and expenses in connection with a hiring scheme to be reduced to the absolute minimum, and, at first glance, it may be thought that the suggestion herein contained is too cumbersome and expensive, especially for the smaller lines of apparatus. My contention, however, is the reverse, and that the system, once initiated, is remarkably efficient, inexpensive, and altogether a commercial asset of considerable value, one which many times over repays for the initial expenditure.

The system referred to can be quickly grasped by a glance at this reproduction of a card drawn up for the occasion :—

Description..... | Maker's ref. .....
..... | Corporation ref. .....

Bought from..... On..... Cost.....

Date hired.	Name.	Address.	Rate.

Inspected on .....

Remarks.....

Naturally, this is intended only as a rough guide and may readily be altered to suit individual requirements; thus, a space may be provided for information as to date and cost of any repairs that may have been necessary. A suitable cross index under consumers' names and apparatus under the supply authorities' serial numbers should be made.

In conclusion, it only remains to be said that these notes are not intended to cover all the points calling for consideration; they constitute only a brief survey of some of the more prominent features of the successful hiring business, and of the possibilities thereof. Mention has been made in these notes more than once of heating and cooking apparatus, and there is little doubt that, marvellous as has been the growth of this class of business during the last few years, the next decade should show still greater strides now that the difficulties inseparable from the development and application of new designs have been overcome. And in regard to power, he would be a bold man who would venture to estimate the numbers of effete and inefficient gas engines which have been lately discarded in favour of electric motors. It is commonplace to say that the huge output of munitions of war has only been made possible by electric power; and, if it had not done so before, the electric motor has certainly now come into its own. In these two classes of apparatus, to specify no others, the hiring system will undoubtedly reach huge developments in coming years.

Agricultural Machinery Research.—According to the *Times*, the Board of Agriculture and the Development Commissioners have been considering the establishment of a Research Institute to investigate problems relating to agricultural machinery; it is suggested that this should be established at Cambridge in association with the existing Schools of Engineering and Agriculture. The principal officers would be a director experienced in mechanism, and an assistant-director experienced in agriculture. Land for experimental work would be available on the University farms.

SOME SOURCES OF ERROR IN THERMOMETRY.

By E. B. PAUSEY.

It is a curious attribute of human nature that fallacies—especially those which contain a half-truth—are apt to maintain their hold on the imagination of the majority of mankind with great tenacity. Witness the almost pathetic belief of the average man in the inherent inability of the photographic camera to record anything more or less than a true and complete image of any object or view upon which it is exposed; this belief persists even at the present day, in spite of all the evidence against it daily presented by the cinemas, where impossible occurrences usually form a main feature of the programme. In like manner a very large number of engineers appear to hold an equally unshakeable belief in the veracity of their thermometers, although, as I propose to show in this article, it is quite within the bounds of possibility for a thermometer, well made and correctly calibrated though it may be, to tell the most arrant lies—lies which, in some cases, may cost the owners of a plant considerable sums of money, and in others keep them in a fool's paradise with regard to the efficiency and safety of their plant.

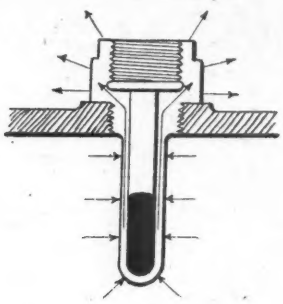

Fig. 1.

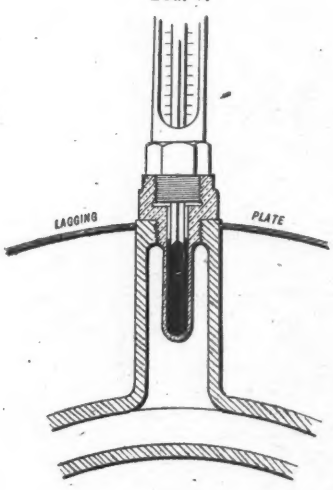

Fig. 2.

Fig. 3.

Everyone who is responsible for the operation of plant for the generation of electrical energy—or, indeed, of any form of power plant—should be quite aware of the fact that if economical and satisfactory working is to be expected regular and reliable temperature records are a necessity. The common mercury-in-glass thermometer is by far the most popular instrument for this purpose, and it must be granted that it is fully entitled to its popularity, as it is, in itself, capable of very high accuracy. Unfortunately, however, its reputation for accuracy is itself an indirect cause of serious errors, which are commonly overlooked, for it is this reputation that leads engineers to that unquestioning belief in the infallibility of thermometer readings to which I have already referred. So far from there being any ground for this belief, the temperature indicated by the height of the mercury in the stem is simply and solely that of the mercury in the bulb, and unless the latter approximates very closely to that of the body whose temperature is to be measured, the records taken cannot be either useful or satisfactory. Yet, in spite of this rather obvious fact, thermometers are frequently so incorrectly applied, that their indications diverge from the truth to a surprising extent; these divergencies are usually quite unsuspected by those in charge of the plant, who accept the temperature readings without doubt, utilise them in calculating efficiency percentages to, perhaps, two decimal places, and are often incredulous when the existence of large errors is pointed out. Considering the importance of the subject, the amount of thought hitherto given to the correct application and use of thermometers in practice is very meagre, and but little information is available either from text books or the technical Press; in these circumstances, I venture to hope that these brief notes may direct attention to this matter, and be of some assistance to engineers in charge of power plant. The few examples described in the present article, out of many which might be quoted, are quite sufficient, I believe, to demonstrate the need which exists for the devotion of greater care to this matter.

It is curious, but nevertheless a fact, that in the majority of cases, thermometric errors favour the manufacturer of plant as against the purchaser. I do not, of course, doubt that this circumstance is purely accidental, nor do I desire to suggest that manufacturers install thermometers with any other view than the correct registration of temperature; but I do say that it strongly emphasises the need for the user to assure himself that the thermometers and pockets fitted to his plant are such as will serve their purpose in a satisfactory and accurate manner.

A type of thermometer pocket as commonly used is shown in section in fig. 1. In order that the transfer of heat from the steam or other fluid surrounding the pocket to the bulb shall be as perfect as possible, the pocket is intended to contain oil or, preferably, mercury. There are two sources of inaccuracy in such a fitting, the most important of which is the effect of its situation—dealt with below; the second, which is usually negligible, but which still merits consideration, is loss of heat by conduction and radiation. This loss is illustrated by the arrow-headed lines, which represent heat received by the pocket from the steam, or other fluid, conducted up the walls of the pocket, and radiated away from its exterior portion. By making the pocket reasonably deep, by reducing the thickness of its walls as much as is consistent with safety, by using a thermometer such that the bulb is nearly at the bottom of the pocket, and by using just sufficient mercury to immerse the bulb completely, and no more, this source of error may be reduced to an almost vanishing quantity. The aim of these precautions is to render the conduction of heat from the lower part of the pocket to the exterior as difficult as possible.

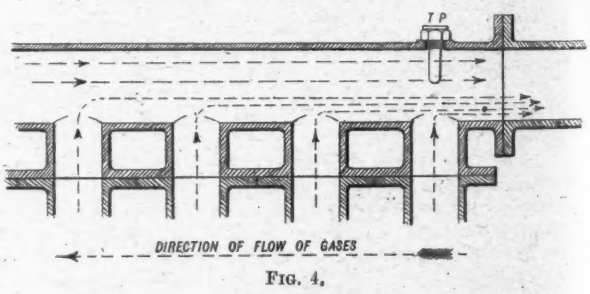

Fig. 4.

When the pocket is fixed in position, it will really receive heat, not from the whole of the fluid in the pipe or other vessel, but from a comparatively small sample thereof, and it is, therefore, essential that this shall be a representative sample. This is a most important matter, and want of attention to it is the cause of very large errors indeed. The pocket should be fitted in such a position as to be fully exposed to the direct flow of the fluid. Often it is placed in some out-of-the-way corner, where the flow is sluggish and the radiation losses possibly high, and in such a case it

cannot give a true reading. Fig. 2 is an example of this kind of faulty application, probably about as bad an example as could be found. The thermometer is supposed to indicate the temperature of the steam at the stop valve of a steam turbine, and it is, therefore, a most important item in the calculation of the efficiency of the machine. The pocket is screwed into the upper part of a hollow cylindrical projection cast on the stop valve body. This arrangement has the apparent object of raising the thermometer to a position clear of the lagging plates on the valve body; but while it certainly serves this purpose, one cannot altogether help wondering whether there may not be any ulterior object in such a design. So far from the pocket being fully exposed to the direct flow of the steam a lot of trouble seems to have been taken to place it where there can hardly be any flow at all; moreover, the radiation losses from the cylindrical projection are bound to be excessive, and, to make matters worse, the bulb of the thermometer only reaches about halfway to the bottom of the pocket. The net result is that the thermometer reading is from 80° F. to 100° F. below the actual steam temperature, as indicated by a more correctly applied thermometer close by. Such an enormous inaccuracy makes this one example alone sufficient proof of the importance of more careful attention to these fittings. If the arrangement had been specially designed for no other purpose than incorrect registration of the superheat temperature it could hardly have been better adapted to that end.

When the temperature of a liquid flowing in a pipe is required to be measured, it is necessary that the pocket shall not only be exposed to the direct flow, but also that it be not fitted in a place where the liquid is liable to separate into strata of different temperatures; if no attention is given to this matter, and the fitting is situated in such a place, the natural result will be that the reading of the thermometer will by no means represent the mean temperature of the liquid, but simply that of the stratum in which the pocket happens to be immersed. Fig. 4, which exemplifies a case of this source of error, shows a thermometer pocket as generally fitted to the outlet of an ordinary economiser, for the purpose of indicating the temperature of the feed water supplied to the boilers. From the reading of this thermometer, the probable effect of the economiser in increasing the overall economy of the plant is reckoned. I shall now show that its readings are unreliable, and that any estimates of the efficiency of the economiser based upon them are erroneous and exaggerated—at the same time admitting that the actual usefulness of the economiser is unquestionably so great that it needs no exaggeration, either thermometrical or otherwise.

The thermometer pocket, T P, is shown in its customary position, namely, screwed into the upper main header immediately over the branch leading from the last top box. Now, the temperature of the water issuing from the top boxes is not by any means equal throughout the economiser, but varies in a rather interesting manner, which can be roughly investigated by feeling the branch pipes with the hand. Economisers are generally arranged for the water to enter at the end where the flue gases make their exit, and to leave it at the opposite end where the gases enter, thus, in fact, applying the "contra-flo" principle. If the rough test of the temperatures be started at the water inlet end it will usually be found that the branch at that end is moderately warm, and that at first the temperatures increase as the outlet end is approached; so far, this is what might be expected from the decrease in the temperature of the flue gases as they pass through the economiser. The maximum will not, however, as one might suppose, be found at the water outlet end, but is generally somewhere near the middle, the temperature of the branches thereafter falling off more and more rapidly as the water outlet end is approached, until that of the last branch—the one immediately below the thermometer pocket in the illustration—may be but little above that of the inlet water, in spite of the fact that the tubes at this end of the economiser receive heat from the flue gases when the latter are at their hottest. This is due to the flow of water in the economiser tubes not being equal throughout the economiser; it is very much less at the water inlet end than at the outlet end, owing to a large proportion of the water being carried by its own momentum past the branches at the inlet end to those at the outlet end. The natural result of this is a lower temperature rise in the tubes at the outlet end, as the consequence of the larger volume of water passing through them. Now, the water in the top main header, owing to its slow rate of flow in the branch pipes, does not become mixed to any great extent; an idea of its behaviour is given by the arrow-headed dotted lines in fig. 4, which show how the colder water from the tubes at the outlet end flows along the bottom of the header, missing the thermometer pocket altogether. The latter is, therefore, immersed only in the hotter water in the upper part of the header, and thus it gives an utterly fictitious high reading, the error in one case which has come under my observation ranging from 30° F. to 60° F. When it is remembered that, according to the rough rule of 1 per cent. increase of overall economy for each 10° F. increase of feed-water temperature, this error represents a non-existent gain of 3 per cent. to 6 per cent., its importance needs no further emphasising. To obtain correct readings, the thermometer should be installed in such a position that it indicates the temperature of the water after it has passed through a mixing chamber or a valve of the globe type.

One field where there is a wide scope for scientific consideration is the means for taking the temperature of alternators. The usual method of doing this is merely to hold an ordinary mercury thermometer with its bulb against the core or coils. This method is crude and unscientific; it is unlikely to give the maximum temperature of the windings; it is subject to the personal factor of the observer, a very variable and uncertain quantity; and it is liable to be applied in a more or less irregular and haphazard manner. As an alternator has no commutator to visualise—as one may put it—heavy loads by sparking and flashing, the extent to which it may be loaded is limited by its temperature, and if this is taken in the usual unsatisfactory manner, there is bound to be a good deal of doubt as to whether a machine has a sufficient margin of safety at heavy loads. Particularly during times of emergency, such as sudden heavy increases in load or breakdowns, are serious risks likely to be taken in the way of overloading. On the other hand, machines are sometimes started up and put on load merely to deal with short peaks, which could be quite safely dealt with by overloading the machines already on load for a short time, provided proper and convenient means of indicating their temperatures were in use. Such a means would be an electrical resistance thermometer, with its resistance element fitted closely up to one of the coils of the stator winding, in such a place that it would be subjected to the maximum temperature of the machine. The indicator itself should be fitted as a switchboard instrument on the machine panel, so that the temperature of the alternator could be easily and regularly taken and recorded on the station log sheet in the same way as readings of other instruments. If some arrangement of this kind were in general use, there is no doubt that all power stations would be run with greater reliability, and some, at least, with greater economy.

Readings of thermometers which are fitted in places difficult of access—such as superheaters, economiser inlets, &c., are commonly very unreliable, owing to very serious errors introduced by the personal factor of the observer. Even the most conscientious attendants naturally feel some repugnance to scrambling over dusty, hot boilers and flues, up dark, dirty trenches or over grimy condensers every half hour or hour, especially in the small hours of the night shift, to take temperatures which usually show few important variations. Human nature is only human nature after all, and its weaknesses must be allowed for. An electrical or any other form of thermometer, capable of indicating upon an instrument which can be fixed in any convenient position the temperatures of apparatus in not easily accessible places, would ensure that these temperatures would be taken and recorded as accurately as those in the engine room itself. As a check on the readings of the distance instrument an ordinary mercury thermometer ought to be used occasionally, when a comparison between the readings of the two instruments would discover any errors, which could then be corrected.

A careful and reliable record of the temperature of the interior of a coal stack might save heavy loss from fire by

giving timely warning of overheating. Fires, once started, are very difficult to keep under control, especially in the case of large stacks. It is poor comfort for the loss of a stand-by stock of coal from this cause to be able to claim compensation under an insurance policy, since money, even paper money, is not an efficient substitute for boiler fuel, and, in these times of scarcity, it cannot always be quickly exchanged for it. Coal-stack temperatures are commonly taken—when taken at all—by lowering a thermometer down a pipe driven into the stack. It is not difficult to devise an improvement on this arrangement that is both cheap and satisfactory. In fig. 3 is shown an ordinary mercury thermometer, which should be graduated to above boiling point—say, 225° F.—immersed in water in an ordinary water gauge-glass, the ends of which are closed by tightly-fitting corks. The lower cork should be stuck in with shellac varnish, so that, in case of over-pressure, it will remain in its place, and the upper one be driven out; otherwise, there would be a risk of losing the thermometer. A small string becket is attached to the upper part of the glass by a whipping of fine twine or strong thread, the whipping being well varnished to prevent it slipping. The arrangement may be lowered down a pipe by means of a string tied to the becket. The pipes should be closed at the bottom, so that sufficient water or oil may be put in them to cover the tube containing the thermometer, and pointed so as to be easily driven down into any desired part of the stack. The advantages of this system of taking coal-stack temperatures over the usual method already mentioned are that, as the water in the tube retains its heat when the instrument is drawn up to be read, there is no uncertainty due to the mercury falling rapidly, as is the case with an ordinary thermometer, and that if the pipe just contains sufficient liquid to cover the glass tube, the thermometer will indicate the temperature of the immediate neighbourhood of the bottom of the pipe very accurately. If no liquid is put in the pipe, errors will arise, partly from the bad conductivity of air and partly from the effect of convection currents in the pipe; this last source of error will be considerably increased if a large excess of liquid be used.

In addition to the foregoing sources of error, which are external to the thermometer, there are others which lie in the instrument itself. One, which is extremely annoying and often difficult to deal with, frequently occurs in thermometers used in high-temperature measurements, say above 250° F. This is the "splitting up" of the mercury column, a more or less rapidly-increasing portion of it taking up a position in the extreme top of the bore of the tube, a position from which it can only be dislodged with difficulty. The cause of this is probably that the mercury evaporates owing to the high temperature, fills the vacant part of the bore with mercury vapour, this vapour condenses in the cooler upper part of the bore, and so forms the "split off" portion. Some thermometers are made with a small cavity at the upper end of the bore; when this is the case, all that is necessary is to heat the bulb carefully over a spirit lamp or gas flame until the break in the mercury rises into the cavity; the break will then rejoin, and on cooling, the instrument will be all right again. Great care must be taken, however, not to overheat the bulb, since if the glass is softened at all, it will be collapsed by the pressure of the atmosphere—or burst, if the thermometer be nitrogen filled. All thermometers for high temperatures—say over 250° F.—should have such a cavity in the bore; if they have not, it is often difficult, and sometimes impossible, to bring down the split-off portion of mercury. Swinging or tapping the thermometer may have the desired effect, but, even when brought down, it is not at all easy to get the break to join. This is probably due to a small amount of mercury vapour between the two portions of liquid mercury acting as a cushion, aided, no doubt, by surface tension.

Another case of splitting of the mercury column occurs when an ordinary thermometer, in which the space above the mercury is vacuous, is used for the measurement of very high temperatures. Obviously, in a thermometer of this kind, the only pressure on the mercury in the bulb is that due to the head of mercury in the stem, which, in thermometers of the usual size, about 12 in. long, is not above 6 lb. per sq. in. absolute when the thermometer is held vertically. The boiling point of mercury under a pressure of one atmosphere is 675° F., but at this reduced pressure it is lowered to between 550° F. and 600° F., so that if the temperature to be measured is higher than this figure, the mercury in the bulb will boil, and the vapour given off by it will drive the mercury column right to the top of the stem; therefore the temperature at which the mercury in the bulb boils forms the highest limit of the scale. In thermometers which are required to read to more than 600° F., the boiling point of the mercury in the bulb is raised by filling the space above the mercury column with an inert gas—such as nitrogen—at a pressure of about 25 atmospheres. The upper limit of the scale is then raised to about 1,000° F. It should be noted that, while nitrogen-filled thermometers furnish a satisfactory solution of this difficulty, they are just as liable as those of the ordinary vacuous type to the trouble of the upper portion of the mercury column splitting off, as described in the preceding paragraph, since evaporation from the surface of the mercury and condensation in the end of the stem goes on independently of the presence or absence of inert gas in the space. Moreover, if this should occur, the presence of high-pressure gas between the two portions of mercury renders their reunion very difficult, if not impossible.

On occasions when specially accurate temperature indications are required, as, for instance, official tests of new plant, extra precautions ought to be taken with the thermometers, particularly with those which are to be used for temperatures which have considerable effect on efficiency calculations, such as those of superheated steam, feed and circulating water, exhaust steam and condensate. The ordinary brass-cased thermometers, such as are commonly fitted for permanent use, should not be used, but should be replaced by special stem thermometers having a limited range, and as open a scale as possible. For taking the steam temperature, which may be expected to lie within the limits of, say, 500° F. to 550° F., a thermometer having a range of about 450° F. to 600° F. should be used; it could easily be read correctly to one quarter of a degree; the other important thermometers should similarly be specially adapted to their work. A small source of error will be eliminated if thermometers which are to register high temperatures are kept at approximately their working temperature for some hours previous to the test, as glass, on being raised from a low to a high temperature, does not immediately expand to the corresponding volume, but continues its expansion slightly during a considerable time. All the thermometers should be checked both before and after the test by comparison with a carefully calibrated master instrument. In the calibration of thermometers the whole of the stem and bulb is at an equal temperature throughout, and the scales are made on this basis. In the case of thermometers for registering high temperatures this condition is not often approached in practice, and, as mercury has a much higher coefficient of expansion than glass, it becomes necessary in accurate work to correct for this error. This is done by means of the following simple formula:—

$$T_c = T_r + k\,n\,(T_r - t),$$

where T_r is the apparent temperature as read,
T_c is the corrected temperature,
t is the mean temperature of the stem,
n is the number of degree divisions of the scale occupied by mercury and exposed to the temperature t,
k is a constant whose value is 0·000083 for the Fahrenheit scale, and 0·00015 for the Centigrade scale.

The temperature t of the stem cannot easily be obtained accurately, but a rough approximation will suffice.

In concluding these notes, I trust that they will have the effect of drawing the attention of the engineering public to the importance of giving due care and attention to these instruments. They are not written from the point of view of an expert, but are the result of practical observations in everyday working, and are intended to be read in that light.

THE CONTROL OF ROTARY CONVERTERS.

In a brochure recently issued by the British Thomson-Houston Co., Ltd., some novel and interesting particulars are given regarding the methods available for obtaining from a rotary converter a variable D.C. voltage whilst the A.C. voltage remains constant, and *vice versa*. Normally the ratio of the A.C. to the D.C. voltage is practically constant for any given load, and in order to vary the ratio it is necessary to introduce reactance on the A.C. side, or to employ a booster machine, an induction regulator, or split-pole control. The reactance method is the simplest and cheapest, and is suitable for use where the voltage variation required does not exceed 15 per cent., which is usually the case in practice. The effect of the reactance depends upon the excitation of the machine; if the field current is reduced below the value which gives unity power factor at the slip-rings, a lagging current is drawn from the A.C. mains, and the reactance lowers the slip-ring voltage, and therefore also the D.C. voltage, while if the field current is increased, a leading current is drawn and the D.C. voltage is raised. Evidently the power factor varies with the D.C. voltage, but even with 15 per cent. variation of voltage the power factor at full load is not less than 90 per cent., as shown in fig. 1, which also shows how the power factor varies with any given voltage, how it varies when the voltage is varied, and the wattless current expressed as a percentage of the full-load current which will be drawn from the line under various conditions of load and voltage. It will be seen that at constant voltage the wattless current varies only within moderate limits from no load to 50 per cent. overload, and that the power factor of a system may be greatly improved by adjusting the conditions so that a large leading current is drawn from the line. In the figure, the uppermost curves relate to the maximum voltage required and the lowest to a value 15 per cent. lower, but precisely the same curves hold good if the conditions are arranged so that the machine runs at normal voltage with unity power factor, the top and bottom curves then representing the performance with voltages respectively 7½ per cent. above and below the normal.

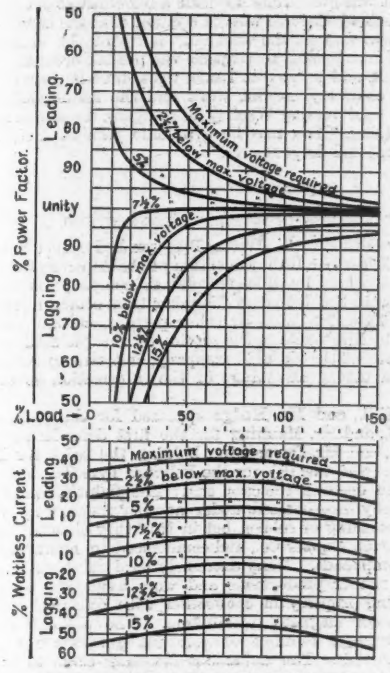

Fig. 1.—Curves Showing Power Factor and Wattless Current of a Reactance-controlled Rotary Converter.

The use of a booster was one of the earliest methods of varying the voltage ratio, and enables the power factor to be controlled independently of the load and voltage; but with modern rotaries equipped with commutating poles and giving greatly increased outputs, booster control seriously affects the commutation, and is found inferior to other methods.

Control by induction regulator is free from this drawback, while it retains the advantage that the power factor is independent of the load and voltage. In this case the D.C. voltage is varied by inserting an induction regulator between the transformer and the slip-rings, which increases or reduces the A.C. voltage applied to the rings. The regulator performs exactly the same functions as the booster, but without affecting the commutating conditions of the rotary, so that machines can be built of the largest output for a given size, without complications, and can be made to give a voltage range of 30 per cent. or more. In the latest practice the regulator, which was formerly a separate item, is mounted on the bedplate of the converter, which is then of about the same size and cost as a booster-controlled machine, and is self-contained. The design of the regulator has been improved, and the combination, which is illustrated in fig. 3, is useful for correcting a low power factor, operating on 90 per cent. leading power factor at full load, at any voltage.

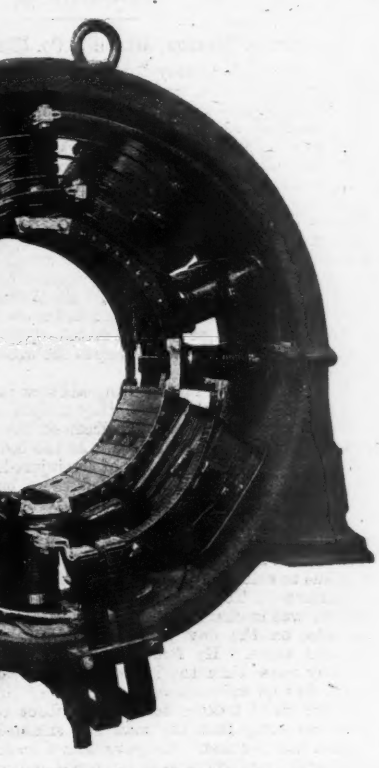

Fig. 2.—Magnet-Frame and Windings of B.T.H. 250-kw. Split-Pole Converter, with Commutating Poles.

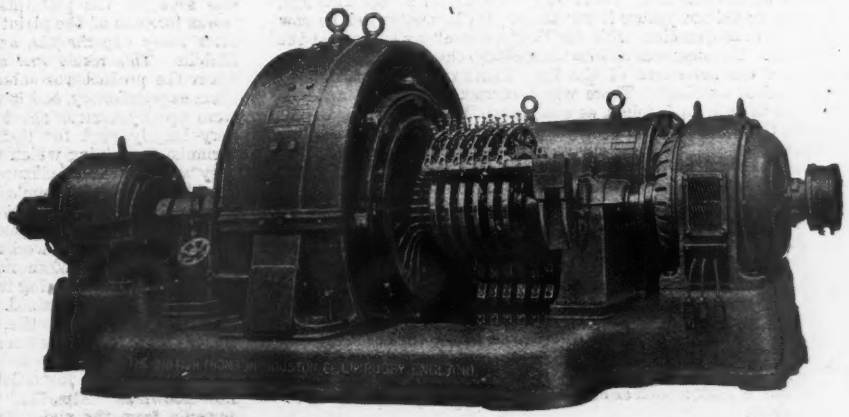

Fig. 3.—B.T.H. 500-kw. Self-Synchronising Rotary Converter with Induction Regulator, A.C. Starting Motor, and Separate Exciter.

The remaining method of control—the split-pole device—was patented by the B.T.H. Co. and developed for 25-cycle work, giving a D.C. voltage range of 25 per cent. with constant A.C. voltage. In this system each of the field poles of the rotary is divided into a main pole and a regulating pole, the latter being arranged for excitation either in the same direction as the main poles or in the opposite direction. As the D.C. voltage is proportional to the algebraic sum of the fluxes of both poles, while the A.C. voltage is proportional to the vector sum of the A.C. E.M.F.'s produced by the two fluxes, and the algebraic sum can be widely varied without greatly affecting the vector sum, the voltage ratio can be varied over a long range; unity power factor can be obtained under any conditions of load and voltage, and as the control is effected in the armature of the

converter itself, this is the simplest type of control in which the power factor is required to be independent of the voltage variation. Fig. 2 shows the field-magnet system of a split-pole rotary of 250 KW., with commutating poles.

LEGAL.

Woolley *v.* Watson, Marsh & Co. (Brondesbury), Ltd.

At the Lambeth County Court, before Judge Parry, sitting with the Medical Referee, on December 19th, an application was heard for the review and termination of an award under the Workmen's Compensation Act made to Thomas Woolley, electrician, the employers being electrical engineers, of Brondesbury, N.W. The case has already been reported and commented upon in the Electrical Review.

On May 4th, Woolley was working for the firm at Pike's Circuit Cinema, Charing Cross, and he alleged that when going to fetch some material, a labourer employed by another firm was wheeling a barrow full of cement up a plank, which tipped over, a bag of cement falling on his left leg and displacing a cartilage. He had not been able to work since, and the Judge, on October 5th, held that the accident arose out of and in the course of his employment, awarding him £1 a week from the date of the accident as compensation, which had been paid him up to the week preceding the present hearing.

Mr. Kingsbury, for the firm, said that in asking for the review and termination of the award, they maintained that the man had entirely recovered from the effects of the accident on November 3rd, a month after the award. At the last hearing, mention was made of an X-ray photograph of the injured knee taken at Charing Cross Hospital when he attended there, but it was not produced. After considerable trouble they had been able to procure the photograph. The difficulty had been whether the condition of the man's leg was due to the accident or to some old-standing disease, and the photograph showed that the condition of the leg was due to arthritis of the knee joint, and not to the accident.

Alfred R. Tothill, medical student in his fifth year, stated that he was in charge of the casualty department at Charing Cross Hospital on the day Woolley met with his accident and was brought there. He found both knee joints inflexed, the left slightly more than the right. There was no swelling, and he could find no evidence of a fracture or limitation of the joint. Woolley stood talking to him for about ten minutes. Witness made an entry that the man had strained the knee joint, and treated him for that. He gave him a week in which to recover. He saw him again that week, but could find no development. He did not find any evidence of any loose cartilage, though he suggested to Woolley that that was what he was suffering from, a suggestion he readily accepted as the cause for the pain from which he was suffering, or said he was. Witness came to the conclusion that he was exaggerating his condition. On June 9th he saw him once more, when he sent him to the consulting surgeon, Mr. Daniel, as witness would have nothing more to do with him. He came to the conclusion that at that time Woolley had entirely got over the effects of the accident. He never prescribed for a loose cartilage, because he did not believe it was there. On November 3rd he saw Woolley in conjunction with Mr. Cooge, consulting surgeon at the hospital. The man was able to walk easily, there being no impairment of the movement of the leg. There were then no signs of a detached cartilage. There was a certain amount of arthritis present in both knee joints, as was shown by the creaking of the joints, this being apparently of long standing. In cross-examination, witness said he never saw any swelling of the knee joints.

Dr. Pastell, resident casualty officer at Charing Cross Hospital, said he examined Woolley in the hospital on November 3rd. He was not suffering from any loose cartilage, but from arthritis in both knees. The X-ray photograph showed the disease in a more extended form, and no evidence of a loose cartilage. There was creaking in the joints. Witness thought then the man was quite able to work. He had been advised to wear a knee bandage, but said he had only had it on once or twice. In cross-examination, Witness said it was impossible to say how long the man had suffered from arthritis, but it was present before the accident.

Mr. Bloxham, for Woolley: Do you say that he is capable of doing the same work now as he did before the accident?—Yes.

Judge Parry: Such as climbing ladders and kneeling down?—I think so.

Dr. M. Dutch, physician at the Lewisham Military Hospital, said he examined Woolley on August 27th, and found no evidence of fluid in the joint, or of a movable body, but he found arthritis present, both knees suffering from it. He thought the man was quite fit to do the same work as he did before the accident. The disease, in his opinion, was of long standing.

Dr. Ivor Davies, specialist, said he also examined Woolley, and found distinct evidences of arthritis. It was very marked, and was of years' standing. There was no evidence of an accident to the knee joint. In cross-examination, Witness said he was quite capable of climbing ladders and kneeling.

On behalf of Woolley, Dr. Robertson, his panel doctor, said he had attended him for some years, and he had never complained of not being able to do his work through arthritis in the knees. He came to him during the time he was attending hospital, and found him suffering from a very swollen and inflamed knee joint. He was of opinion that the man had displaced a cartilage, and recently recommended him to wear a bandage. He did not yet think he was fit for work, and certainly did not think he could climb ladders. In cross-examination, witness said he thought it would be some weeks before he could go back to work.

After the Medical Referee had examined Woolley, Judge Parry asked if he had made any effort to do any kind of work?

Applicant: No; I have done nothing whatever.

Judge Parry said the Medical Referee had spoken very strongly to Woolley about getting back to work. Addressing the man, he said he could work very well on the level if he tried, and now was his time to do something, for men were needed. He must get to work as soon as possible.

Woolley said he did not feel able to go up ladders with safety.

Judge Parry said he could find plenty of work where he would not have to do that. He could not go on getting his £1 a week for ever. It was quite time he made a big effort to get back to work. The Medical Referee was of opinion that the condition of the left knee was due to the accident, and that the arthritis arose out of it. He suggested to suspend the present order to pay the man £1 a week, and grant him 15s. a week until February 1st, in which time he could try and find work, and the result could be reported to him. Addressing Woolley once again, he urged him to get to work, saying, "You may have a little pain at first, but you must stick that and do your best."

Secret Process in Rubber Manufacture.

In the Chancery Division Mr. Justice Peterson had opened before him on Tuesday, December 19th, the action of the Alperton Rubber Co. *v.* Manning and others, by which the plaintiff company sought an injunction to restrain the defendant Manning from communicating to the Belgium Tyre Co., Ltd., or other persons, certain information acquired by him while in the service of the plaintiff company for the benefit of the plaintiff company, and also to restrain the Tyre Co. from taking advantage of the information so communicated.

Mr. Hughes, K.C., and Mr. Hodge appeared for the plaintiff; Mr. Herbert, K.C., and Mr. Manning for the first defendant; and Mr. Tomlin, K.C., and Mr. Devonshire, holding the brief for Mr. Deighton Pollock (who was ill), for the Belgium Tyre Co.

Mr. Hughes, in opening the case, said: The plaintiff company, who were originally incorporated under another name, were connected with the washing of rubber, but in 1912 they changed their name to the Alperton Rubber Co., and commenced to manufacture various rubber compounds. Many extremely hard substances now used were really rubber productions and were important because of their insulating property in connection with electrical work. They were used for magneto distributors. The plaintiff company had a very large number of different formulæ for the mixing of the rubber. The defendant Manning came to their works early in 1912. There was no written agreement of service. One important mixing arose in the following way:—The plaintiffs did a considerable amount of work for the Bosch Magneto Co., and that company used a material called Stabilit, which at that stage was produced in Germany. After the war began it became impossible to get Stabilit from Germany; the Bosch Co. in England was very anxious to get a satisfactory substitute for it, and approached the plaintiffs, amongst others, with a view to getting them to manufacture a satisfactory substance. An analysis was sent for the plaintiffs' assistance by the War Office. The works foreman of the plaintiffs was a man named Fisher, and he, after many experiments, arrived at a satisfactory substitute for Stabilit. This result was attained in the month of June, 1915, when the product was submitted to the Bosch Co. and passed by them as satisfactory, and it was also passed by the War Office, who were equally anxious about the matter, as these magnetos were very largely used for their engines. There were many other formulæ for mixing which the plaintiffs had, and in some cases they worked out the mixtures themselves; in others, the customers would supply the formula for the mixing they required. The formula would then be kept on two cards, one of which would be given to Fisher and the other to a man named Drummond, in the drug or compounding works, where the actual mixing was done. The works records, when not actually required, were kept in the company's safe, care being taken to prevent people getting at the knowledge they contained. On June 29th the company gave Manning a month's notice, suggesting that he should take a holiday until the expiration of the month, so that from June 29th he was not on the premises. After he left, Manning invited Fisher to join him in the formation of a company to work a substance now known as "Alperlite," pointing out that he had obtained the formula from the plaintiffs' loose-leaf book. It was found that the formula was not in the book he had left behind, and Fisher and Drummond were the only persons who could know the formula. The two cards had been removed from the book, and the plaintiff company would have no means of ascertaining this mixture. The defendant stated that he had had an offer of £200 for the formula, but Mr. Fisher, after saying that he would think the matter over, wrote declining to have anything to do with it. It would appear that Mr. Manning had removed one of the loose-leaf books from one of the company's offices, and he claimed that it was his own property. Counsel did not see how that could be, as it was paid for with the company's money. He had, however, offered to return the book, but that was not sufficient. Shortly after the termination of his engagement with the plaintiff company, Manning got into communication with the Belgium Tyre Co., who were also manufacturers of a certain class of rubber goods, and it would appear that as early as July, before his engagement with the plaintiffs had terminated, he was giving them an

order. The defence was a denial that Manning was making use of any knowledge that he had acquired while in the service of the plaintiffs, and the Belgium Tyre Co. alleged that they had acquired nothing from Manning over which the plaintiffs had any rights. They admitted that Stabilit was manufactured in Germany, but not entirely in that country, and they denied that any formula used in the plaintiffs' business belonged exclusively to the plaintiffs.

Witnesses were called for the plaintiffs to prove that Manning knew the formula of the plaintiffs' Alperlite, and that the Belgium Tyre Co. were now supplying a substance identical with it. The success of the compound depended upon the formula and not upon the skill of the workman who compounded it, and any departure from the formula would tend to alter the specific gravity, the insulating properties, and the flexibility.

At the conclusion of the plaintiffs' case the hearing was adjourned until next sittings.

Rating of Electric Tramway Lines.

London County Council's Appeal Successful.

At the County of London Quarter Sessions, at Clerkenwell, Mr. A. P. Lawrie, K.C. (Deputy-Chairman), delivered judgment in this appeal against the quinquennial assessment by the Assessment Committee of the Holborn Union of tramway lines in the Boroughs of Finsbury and Holborn.

Mr. Lawrie, in giving judgment, observed that throughout the hearing the fact had more and more impressed itself upon them that this case need never have come into Court, and that was equivalent to saying that, particularly at this time, it never ought to have come into Court. It was a most deplorable thing to see two public bodies spending large sums of money in fighting over matters which should have been easily capable of adjudication without litigation. The Court could but feel that if each party had approached the other with the earnest desire to settle, a solution would have been reached very similar to the result they had arrived at, and much of the ratepayers' money would have been saved. But while a settlement would have been easy if that course had been adopted, a decision in the case was by no means so simple. When the parties found that the question was to be fought they both appeared to have shut their eyes to the points telling against them, and have opened them very wide to every point that even appeared to tell in their favour, with the obvious result that differences necessarily increased, the valuations of the rival sides were hopelessly at variance, and both included many obviously untenable claims, either of additions or deductions. When the case came into Court they gladly recognised that every assistance possible was given to them by all concerned, and they could not speak too highly of the great care and ability with which the case had been presented. The Court had asked themselves what a reasonable man would have anticipated at the time in question, and in the main they had based their finding on the accounts of 1914-15, but there were many variations in those accounts available to anybody in 1915, both figures of increased receipts and expenditure already incurred. There were also tendencies which seemed clearly defined which they had had to consider, and they had had to decide which of those would affect a prospective tenant. They had had to discourage certain ascertained figures which would not have been anticipated. Any decision in such circumstances must be largely a matter of speculation. The result they had arrived at was that the total rateable value in Finsbury should be £6,527, which was in the neighbourhood of two-thirds of the amount of rateable value (£9,770) appealed against. The judgment of the Court, therefore, was that the appeal be allowed, with costs, and that those figures be inserted in the valuation lists. His Lordship merely desired to add that that decision might be of some assistance to the parties in the effort he was sure they would make, without any further litigation, in the outstanding cases in the Borough of Holborn.

In reply to Mr. Ryde, the Deputy-Chairman said that, if desired, he could work out the figures for the remaining parishes in Holborn.

Mr. Clavell Salter: I think, perhaps, it would be more convenient to see if we can settle in the light of your Lordship's observations.

Mr. Ryde: Your Lordship says the result arrived at is two-thirds of the rateable value appealed against. I am content to take the assessment in the other parishes as two-thirds of the amount appealed against.

Mr. Clavell Salter: I suppose you are.

The Deputy-Chairman: I suppose Mr. Clavell Salter would not go as far as that. If you (Mr. Ryde and Mr. Salter) can come to some arrangement I think it will be best, but if you cannot I am prepared to work out the figures for the other parishes on the same lines as I have worked out these. The figures are before me, and it will not be an inconvenience to me; so, failing a settlement between yourselves, I am prepared to do it.

Counsel on both sides acquiesced in that proposal.

Mr. Ryde also suggested that they should try and agree the gross values, which, he said, would affect nobody.

Mr. Clavell Salter: I agree that we ought to try and do that.

The Deputy-Chairman observed that he was rather under the impression that the gross values had been arranged.

Mr. Clavell Salter said his Lordship would remember that at the outset of the case he submitted that the appellants had no *locus standi* there on the ground that they had not taken the necessary steps as provided by the statute. He would like the matter to be left open so that it might again be mentioned.

The Deputy-Chairman: Certainly.

Mr. Ryde: I understand that the appeal is allowed with costs as regards Finsbury. I take it, as your Lordship has not worked out the figures for the other parishes, that the question of costs is not yet decided?

The Deputy-Chairman said that was so.

Mr. Clavell Salter: May I take it that the Court would be prepared to consider whether each party should pay their own costs?

The Deputy-Chairman: It is a very substantial reduction, a very large reduction, and it was necessary for the appellants to come here before they could get the reduction.

The matter was then formally adjourned until a day in the New Year, when, it was understood, the result of the conference between learned counsel on both sides would be made known.

Leahy and Others *v.* Kerry Electric Supply Co.

Before the Master of the Rolls, in the Irish High Court, Dublin, a settlement was intimated in an action by Mr. C. F. N. Leahy, and nine others, members of his family, for an injunction to restrain the Kerry Electric Supply Co. from selling milling machinery demised to them at the Fleck Mills, Killarney. The terms were that the defendants shou'd expend £500 on the erection of a power engine in the mills 12 months from the termination of the war, and that they should be at liberty to sell the machinery in the mill on condition of lodging the proceeds in the National Bank, Killarney, in the names, jointly, of plaintiffs and defendants. In the event of defendants failing to erect a power engine, the money lodged is to be the property of the plaintiffs, but compliance with the condition leaves the money with the defendants. His Lordship directed the defendants to pay the plaintiffs' costs.

COLONIAL TELEGRAPHS AND TELEPHONES.

By R. W. WEIGHTMAN, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

No review on this subject would be complete without a reference to the great services the late Sir William Preece rendered to the Colonial Administrations during his lifetime; upon the advice he gave the foundations of many of the Colonial systems were laid, and in many cases the superstructures also were built. From Sir William's association with the Colonial services, and with the gradual standardisation of materials and plant generally in the Home Department, and the publication by the Department of books of technical instructions, the Dominions and Colonies have got more or less into the way of accepting Post Office practice as beyond question.

The Administrations of the Dominions send their chief technical officers around the world to see what is being done, and to cull from the various systems of the world those features which appear to them as being most advantageous for adoption in their own countries. Thus we find in the Dominions practice which is a mixture of British and American, and perhaps even a little Continental. But as the bedrock of it all, British Post Office practice is outstanding.

In the earlier days, many of the engineers, and many officers of other ranks as well, appointed in the Dominions and Colonies, were men who had received their training in the various home services. This still applies to appointments in the Crown Colonies, but it is only rarely the case now in the Dominions. We find the youths of the Dominions qualifying in their respective engineering departments for even the highest positions in them.

There are, however, several Colonies in the tropics in which the heat, and the highly electrical condition of the atmosphere in some cases, are so trying that Europeans must have the relief of a change to a temperate climate at frequent intervals. For the filling of engineering appointments in these Colonies, the Colonial Office will always look for men at home. Higher salaries are offered than men in similar positions in England are paid, but the difference is often swallowed up in the higher cost of living, in the expense of trips to England necessary for health reasons, and, if the engineer be a married man, in the cost of what practically amounts to maintaining two homes; and so in the end the Colonial engineer is rarely as well off financially as he would have been had he remained here. This is surely a matter which should receive the consideration of the Colonial authorities. Low salaries for men in positions of responsibility are false economy.

In another direction the Governments of the Crown Colonies are very short-sighted. They do not encourage their engineers sufficiently to keep themselves up to date. A technical officer, on whose initiative the engineering methods of a Department depend, should be specially commissioned by his Government to visit England at least every three or four years, to enable him to keep in touch with the latest developments.

With well-trained staffs of European character, the engineers of Canada, Australia, and New Zealand are relieved of

much of the worry which falls to the lot of the engineers in those countries where the bulk of the labour is black. In Australia there is an Arbitration Court for the investigation and settlement of labour disputes, and any difficulties of this nature that arise between the administrations and the working staffs of the telegraph and telephone organisations are referred to it. In New Zealand there is a Board of Appeal on somewhat similar lines.

In Canada there is a law under which employés can apply for a Board of Conciliation to discuss the differences between themselves and their employers; but in regard to this, one high official in Canada remarks: "It is a debatable question whether it is of any advantage to either employers or employés."

In South Africa practically all skilled work is done, and all supervising positions are held, by Europeans. The rough work is done by the natives, and many natives are also employed as unskilled linemen. All departments of industry are hampered by the disinclination of the natives to work. Where they are employed as linemen there is not that continuity of service which is desirable, and their utter lack of sense of responsibility is the cause of much anxiety to the engineer. Engineers in all the black Colonies have the same experience in this respect, and in some cases their difficulties are increased by the refusal of their Governments to provide adequate supervision.

The rates of pay to Europeans in the Dominions and Colonies vary generally with the cost of living, and any reference to them would be liable to be misleading, unless the living expenses and the local conditions in each case were also stated.

Of all the Dominions and Colonies, Canada is the only one that has made any headway in the manufacture of apparatus and material for telegraph and telephone purposes. Practically all wire, cable, subscribers' instruments, and manual exchange equipment used throughout the telephone services of the country are made in the Dominion. Automatic exchange apparatus, where this is in use, is obtained from the United States, but even this is now being assembled and built up in Canada. Copper wire, iron wire, and pole fittings are also made to a large extent. Telegraph apparatus is generally got from the States, and also the glass insulators so largely used. Porcelain insulators, where these are used, have been obtained to some extent from the Continent.

In Australia, cast-iron pipes, stoneware conduits, copper tapes and binders, and certain of the pole fittings are manufactured in the country. Prior to 1913, practically all the insulators used came from Germany, but insulators of both porcelain and stoneware are now being made within the Commonwealth. A fair amount of magneto telephone apparatus and switchboard material is obtained from Sweden, while some of the larger exchange switchboard plant and the Strowger automatic apparatus now being introduced come from America. Wire, cable, telegraph apparatus generally, and material of a kindred nature are obtained almost exclusively from Great Britain. It is the rule to invite tenders for all supplies and to give preference to goods of British manufacture.

The other Dominions and Colonies import practically all their plant. This is largely obtained from England, but quantities of telephone apparatus, especially, have in the past been supplied from both the Continent and the United States.

The great distances these countries are situated from their sources of supply, and the delays in delivery that have taken place, have been serious drawbacks to the smooth working of most of the Colonial engineering departments. The engineer in a colony has to prepare his estimates of expenditure well in advance, but he cannot send off his indents for materials until the funds are actually sanctioned by his Government and voted by his Legislature. His estimates cover new works which cannot be proceeded with until the materials arrive, and as it takes anything from three to twelve months to get supplies from British manufacturers, it follows that in many cases the votes have lapsed to the Treasury before the materials reach him, the money is no longer available, and the work cannot go on until the "ins-and-outs" of the whole matter have been explained to the Government. In the meantime the workmen, who have been retained in anticipation of the material coming to hand within a reasonable time, have had little or nothing to do, but their salaries have had to be paid just the same. Strong complaint is frequently made by Colonial engineers in this connection, and the author would like to impress upon manufacturers of telegraph and telephone plant the great need there is for the more prompt execution of orders from the Colonies. Before the war, it was no uncommon thing to hear an engineer say he would not put up with the dilatoriness of British manufacturers, and that he would send his orders to the Continent, and in some instances orders were actually sent there.

In the Dominions and in some Colonies these difficulties are got over by the establishing of "reserve stores" in which ample supplies are kept to meet all ordinary demands. This is a plan which every colony with any considerable system should adopt. It involves the sinking of a certain amount of capital in the stock, but the convenience and the saving of money in workmen's wages are worth more than the amount of interest incurred. Under this system all materials are purchased from the stores, and as they are issued the stores account is credited with their value from the funds provided for the works for which they are required. Delays in carrying out works are thus reduced to a minimum.

Administration.

The methods of administration throughout the Colonies are naturally varied to meet the local conditions, but in all the Dominions (with the exception of Canada) and also in all the larger Crown Colonies the telegraphs and telephones are combined with the postal service of the country, and the Postmaster-General is the officer responsible to the Government for the proper management of the organisation as a whole. In some instances the office of Postmaster-General is a political one, and in such a case the permanent head of the department is the secretary, as in England.

In some of the smaller Colonies telephone exchanges have been established by private companies; but apart from these the telegraph and telephone systems are generally on so small a scale that they do not justify the appointment of a fully-qualified telegraph or telephone engineer to control them, and so this duty falls to the colonial public works engineer, whose responsibilities will include everything of an engineering nature from harbour works to electric bells. Under the public works engineer there will perhaps be a telegraph or telephone inspector, who is often a man of good experience and who will, at any rate, relieve him of responsibility for the practical part of the work.

In the larger Crown Colonies we usually find an organisation on the lines of the home Post Office. It is both convenient and economical to combine the staffs of the postal and telegraph and telephone services of a country under the one administration. Unfortunately, under this system there is a tendency for the commercial staff to assume functions which are liable to bring them into conflict with the engineering section, with a serious loss of efficiency to the latter. The officer who is responsible for the traffic and operating sections of the organisation is inclined to see things only from the point of view of the traffic side, and the views of the engineer are, therefore, liable to be subordinated to his. The efforts of the most capable engineering body in the world may be thwarted and the engineers themselves discouraged if there is undue interference and a lack of sympathy and support from the Postmaster-General and his staff.

The telegraph and telephone services of Canada are quite separate from each other, as in the United States. Sections of the telegraph system scattered throughout the country, and including a considerable mileage of submarine cable, are under the Government, and these are connected up through the lines of the public companies. By far the larger portion of the system is in the hands of the great North-Western Telegraph Co. and the telegraph departments of the two great railway companies, the Canadian Pacific and the Grand Trunk. There is no active competition between the different administrations. Each has its defined sphere of operations, and adequate communication between the different systems is provided.

The telephone services of Canada in the Provinces of Manitoba, Alberta, and Saskatchewan are controlled and mainly owned and operated by the local Governments, but there are also private telephone companies and municipally-owned exchanges in operation. In the other parts of the country the telephones are in the hands of private companies, some of them operating over large areas of country. There is no real competition between the large administrations. Each has its particular area of operations, and the exchange and long-distance services are carried on without opposition. The rural companies are, however, frequently started in competition with the ruling company, and intercommunication difficulties arise.

In the three provinces named each system is obliged by law to give connection to all the others, and the long-distance lines of the three provinces are also interconnected.

The construction of rural lines by independent local companies for the purpose of giving telephone service to farmers is much encouraged by the various Provincial Governments, and in this respect Canada is a shining example to the other Dominions and Colonies.

In the great Australian Commonwealth, the telegraphs and telephones are a close monopoly under the Post Office. The Postmaster-General is the Parliamentary head of the Department, and the permanent head is the secretary. In each of the States the local head is designated the Deputy Postmaster-General, and all sections of the department, including the engineering branch, are under his control. The chief electrical engineer at headquarters is responsible to the secretary, but his position is largely consultative, and there is not that direct line of control over the engineering organisations of the various States which is usual. He communicates direct with the head engineers in the States upon all technical matters, but notwithstanding this, there has not been that close co-ordination of engineering practice which is possible under a centralised form of administration.

Lines for public use in country districts which may not be immediately remunerative to the department may be erected under a system of guarantee, under which the department bears 50 per cent. of the estimated annual loss; the balance of the loss is borne by those interested in the construction of the lines.

The fullest encouragement is given to persons living in the country to erect their own lines, either individually, or con-

jointly with their neighbours, for connection with post offices or exchanges, and the department furnishes applicants with all the information they may require.

In New Zealand the Postmaster-General is a political officer, and the secretary is the permanent head of the administration. In the districts, the chief officer is styled "The Telegraph Engineer," and he is responsible to the chief engineer at headquarters, who is again responsible to the secretary. The department has a complete monopoly of the telegraphs and telephones of the country, and it does not encourage the formation of private companies for the establishment of rural or other lines. Under the Telegraph Act no person or persons may construct telegraph or telephone lines for hire or profit, but there is no hindrance to persons erecting lines for their own use. Many such lines have been put up by farmers in the back blocks of the country where the Government do not feel warranted in spending money on lines which offer little prospect of paying their way. Such lines usually terminate in a Government office or exchange, where they are given connection with the Government system. They are usually built as cheaply as possible, and the service is generally inferior, and faults are of frequent occurrence. The Government exercise no supervision or authority over these private installations.

In South Africa, the telegraphs and telephones are also under the Postmaster-General, who is the permanent head of the Administration, the political chief being designated "Minister for Posts and Telegraphs." Of all the Dominions outside Canada whose telephones are administered by a Government department, South Africa is the first to adopt the "functional" system. With the advent of the Union, the separate administrations were merged in the one central administration and a system closely allied to the "territorial," which had been in force in the Cape Colony, was applied to the whole of the Union. The country was divided into seven districts for administrative purposes. With the great development of the telephone system, this method of administration was found to be unsuitable. The "functional" system was introduced about three years ago, and the Postmaster-General, when in England last year, informed the author that it was working with the greatest satisfaction.

In practically all the Colonies and Dominions the railways belong to the State, and in some of the smaller Colonies a feature of the administration is the amalgamation of the railway telegraph engineering and electrical signalling systems with the engineering department of the Post Office.

All electrical signalling systems are of a cognate character, and come, naturally, within the scope and training of telegraph engineers and linemen, and any Colonial Administration which may contemplate such an amalgamation need have no fear for the results provided a capable and well-organised staff is available.

Under some administrations telegraph and telephone engineers are required to carry out the departmental electric lighting work, and it is a highly debatable question whether this principle is a good one. The author's opinion is that in the specialisation which is necessary to-day in telegraphy and telephony, it is too much to expect an engineer to be expert also in the lighting and power applications of electricity in the larger sense.

(To be continued.)

TRADE STATISTICS OF NEW ZEALAND.

The following figures, showing the imports of electrical and allied goods into New Zealand in 1915, are taken from the official statistics which have just reached this country. The figures for the previous year are given for purposes of comparison, and increases or decreases noted. In each year the country named is the country of origin of the goods.

	1914. £	1915. £	Inc. or dec. £
Leather belting.—			
From United Kingdom ...	4,000	4,000	—
,, United States ...	1,000	2,000	+ 1,000
,, Other countries ...	1,000	2,000	+ 1,000
Total	6,000	8,000	+ 2,000
Belting, other than leather.—			
From United Kingdom ...	27,000	22,000	– 5,000
,, Australia	1,000	1,000	—
,, United States ...	3,000	2,000	– 1,000
,, Other countries ...	1,000	—	– 1,000
Total	32,000	25,000	– 7,000
Engine packing.—			
From United Kingdom ...	11,000	11,000	—
,, Australia	1,000	1,000	—
,, United States ...	4,000	5,000	+ 1,000
,, Other countries ...	2,000	1,000	– 1,000
Total	18,000	18,000	—
Scientific instruments.—			
From United Kingdom ...	5,000	4,000	– 1,000
,, Germany	1,400	—	– 1,400
,, United States ...	1,000	1,000	—
,, Other countries ...	1,600	1,000	– 600
Total	9,000	6,000	– 3,000
Telegraph and telephone wires, iron.—			
From United Kingdom ...	5,000	9,000	+ 4,000
Generators, motors, and transformers.—			
From United Kingdom ...	55,000	44,000	– 11,000
,, France	1,000	—	– 1,000
,, Germany	5,000	2,000	– 3,000
,, United States ...	23,000	26,000	+ 3,000
,, Other countries ...	2,000	2,000	—
Total	86,000	74,000	– 12,000
Electric batteries and cells.—			
From United Kingdom ...	4,000	5,000	+ 1,000
,, United States ...	2,000	1,000	– 1,000
,, Other countries ...	1,000	1,000	—
Total	7,000	7,000	—
Carbons and insulating material.—			
From United Kingdom ...	6,000	4,000	– 2,000
,, Australia	4,000	—	– 4,000
,, Germany	2,000	—	– 2,000
,, Other countries ...	1,000	2,000	+ 1,000
Total	13,000	6,000	– 7,000
Other electrical material.—			
From United Kingdom ...	65,000	67,000	+ 2,000
,, Germany	7,000	—	– 7,000
,, United States ...	26,000	30,000	+ 4,000
,, Australia	4,000	2,000	– 2,000
,, Other countries ...	3,000	9,000*	+ 6,000
Total	105,000	108,000	+ 3,000
* Sweden £4,000.			
Meters, electricity.—			
From United Kingdom ...	10,000	8,000	– 2,000
,, Other countries ...	2,000*	1,000	– 1,000
Total	12,000	9,000	– 3,000
* Germany £2,000.			
Lamps, electrical.—			
From United Kingdom ...	21,000	23,000	+ 2,000
,, Germany	5,000	—	– 5,000
,, United States ...	7,000	7,000	—
,, Other countries ...	4,000*	11,000	+ 7,000
Total	37,000	41,000	+ 4,000
* Holland £2,000.			
Steam engines.—			
From United Kingdom ...	15,000	13,000	– 2,000
Gas and oil engines (except for motor-cars).—			
From United Kingdom ...	70,000	43,000	– 27,000
,, United States ...	18,000	14,000	– 4,000
,, Other countries ...	1,000	1,000	—
Total	89,000	58,000	– 31,000
Boilers.—			
From United Kingdom ...	9,000	13,000	+ 4,000
,, United States ...	—	2,000	+ 2,000
Total	9,000	15,000	+ 6,000
Insulated cable and wire.—			
From United Kingdom ...	117,000	102,000	– 15,000
,, Germany	16,000	—	– 16,000
,, United States ...	8,000	3,000	– 5,000
,, Belgium	6,000	—	– 6,000
,, Other countries ...	—	2,000	+ 2,000
Total	147,000	107,000	– 40,000
Mining machinery.—			
From United Kingdom ...	21,000	15,000	– 6,000
,, Australia	2,000	2,000	—
,, Germany	1,000	—	– 1,000
,, United States ...	4,000	15,000	+ 11,000
,, Other countries ...	2,000	13,000	+ 11,000
Total	30,000	45,000	+ 15,000
Railway and tramway plant.—			
From United Kingdom ...	44,000	56,000	+ 12,000
,, Australia	3,000	4,000	+ 1,000
,, Other countries ...	3,000*	1,000	– 2,000
Total	50,000	61,000	+ 11,000
* United States £3,000.			

WAR ITEMS.

Prohibited Trading.—The "London Gazette" for December 22nd contains further lists of bodies and persons with whom trading is prohibited in Argentina and Uruguay, Brazil, Chile, Greece, Japan, Liberia, Spain, and other countries.

The Sterling Telephone & Electric Co., Ltd.—The whole of the enemy shares of the Sterling Telephone & Electric Co., Ltd., of London and Dagenham, have been acquired from the Public Trustee by Sir John Bethell, Bart., M.P., who will act as chairman of the company. Sir Thomas Bethell and Mr. C. S. Syrett have also been elected directors.

Excess Profits Tax.—In the House of Commons, Mr. Bonar Law stated, in reply to Mr. W. Thorne, that down to the 16th inst. the amount of excess profits duty, including munitions levy, paid into the Exchequer was £73,699,000. That was larger than the estimate for the period.—*Daily Telegraph.*

The Enemy in Australia.—Mr. Jensen, Australian Minister for the Navy, has issued a report showing that two months ago the electric wires of the cruiser *Brisbane* were deliberately cut by unknown persons. He gave instructions for instant dismissal of any workman belonging to the Industrial Workers of the World.—*Times.*

Economy in Metals.—The Minister of Munitions announces that the Metals and Materials Economy Committee, recently appointed under the chairmanship of Mr. C. W. Fielding, will "consider and suggest the action necessary to secure economies in metals and materials as regards their use in munitions of war, taking into consideration matters affecting design, methods of purchase, stocks, import, distribution and control; with powers to take such evidence as may be necessary both from the Departments of the Ministry and from manufacturers.—*Morning Post.*

To be Wound Up.—The Board of Trade has ordered the following to be wound up:—

Mechanical & General Inventions Co., Ltd., 11, Long Acre, London, W.C., dealers in mechanical and general inventions. Controller: T. D. Hawkin, Whitehall House, Charing Cross, W.C.

Salsbury Co., Ltd., 11, Long Acre, W.C., dealers in lamps and accessories. Controller: T. D. Hawkin, as above.

H. Traun & Sons, 25, Goswell Road, London, E.C., manufacturers of ebonite and vulcanite goods. Controller: J. D. Pattullo, 65, London Wall, E.C.

Exemption Applications.—At the Glasgow Tribunal, an electrician in one of the city theatres appealed for exemption on the ground of indispensability. The manager said all the assistants had already enlisted, and the principal electrician in another of their theatres was waiting notice to join the Naval Air Service. It required a skilled man to operate the lights, as in the case of fusing or anything going wrong a panic might ensue and the public would be endangered. The appeal was dismissed, but as the man was a skilled electrician exemption was granted conditional on his undertaking work of national importance.

Chipping Norton Tribunal has deferred for a fortnight an application by the Military Representative for the withdrawal of a conditional exemption certificate held by Mr. W. H. Hellyer, manager for the Electric Light Co.

At the Horsham Tribunal, an employer applied for permission to appeal for an electrical wireman in view of considerable work in hand. The man was in category B3. It was suggested that there were only two or three of such men in the town. The Military Representative pointed out that the regulations provided that such men were only to be exempted when engaged on work of national importance. The application was not granted.

The electrician of a Birmingham theatre is considered to be so necessary for its working that it was stated at the Local Tribunal last week that if he had to go into the Army the theatre would probably have to close down. It was pointed out that his work could only be carried out by a skilled man, and that it was quite unsuitable for a woman. He had to work at a great height above the stage and on the roof, and he was necessary for the safety of the theatre. Exemption was given until March 26th.—*Birmingham Post.*

Before Calne (Wilts.) Rural Tribunal, on December 13th, Walter Gingell, electrical engineer with Lord Walter Hervey, was appealed for, and was allowed exemption until January 15th.

At Dawlish (Devon), exemption was claimed for Mr. C. C. Hodges, manager of the Electric Light Co. For the directors, Dr. C. N. Lovely said that Mr. Hodges was previously exempted to November 30th. Since the last appeal the directors had advertised in the London technical Press, and eight replies were received. Of this number two were considered to be suitable, but on writing for the necessary particulars they heard no more of them. Mr. Leonard Lees, J.P., for the military, opposed exemption, on the ground that Mr. Hodges could be spared. Dr. Lovely replied that if Mr. Hodges went they would have to close down; there was no other alternative. The question of substitution was raised, and Mr. Lees expressed the opinion that it was a case in which it might be tried. In the end the Tribunal allowed exemption until May 1st, the question of substitution being left open to the Military.

Mr. G. C. Booth, electrician, appealed to the Whitby Tribunal for the retention of A. M. Cattle (31), indispensable to the business. Temporary exemption to April 2nd was granted, with V.T.C. condition.

On the appeal of the Military, a certificate of conditional exemption held by Mr. H. A. Harlow (18), electrical engineer, with the Godalming Electricity Co., has been cancelled, and the period of exemption reduced to March 14th and made final.

At Oswestry, the Military Representative asked for a review of the certificate of conditional exemption allowed to two employés of the Electric Light Co., aged respectively 40 and 25, and stated to be indispensable for the carrying on of the undertaking. Confirming the exemption, the Mayor protested against the case being brought before them after the Tribunal had previously decided it.

At Bedford, the Igranic Electric Co. appealed for the retention of F. Morris, who was exempted until June 1st.

At Winchester, the city electricity department appealed for the retention of the City Electrical Engineer (35), the assistant meter tester and inspector (25), a man in charge of electrical installations and repairs (38), the cashier and accountant (37), an engine driver (39), two stokers (34 and 39), three electrical fitters and wiremen (39, 28, and 27), a cable jointer (40), and a man in charge of mechanical and cable work (36). The electrical engineer stated that he had agreed to spare the youngest wireman, and the other two were necessary to keep the installations going. He felt that the staff had been cut down as much as was possible consistent with running the undertaking safely. The Town Clerk mentioned that the Electricity Committee were of opinion that the electricity supply to the city could not be maintained unless they had these men. The Tribunal formally refused the appeal for the youngest wireman, but delayed the calling-up for a month; granted conditional exemption, whilst present circumstances continue, to the cashier and accountant; and exempted the remainder as being in certified occupations.

At Buxton, an electrician appealed for a member of his staff, aged 33, on the ground that he was indispensable in connection with running contracts at several public institutions, &c. His staff was now reduced to two, one of whom was unfit for military service. Ald. Slater: You are not the only electrician in the town. Appellant: I think I am the only qualified practical electrician employing skilled electricians. Exemption to April 15th was granted.

The Witney U.D.C. electricity department appealed to the Oxfordshire Appeal Court for a renewal of the certificate granted to Victor Brice (19), electrician at the supply station. When the last exemption was granted it was arranged that Brice should be released if a substitute was offered. Captain Bailey (Military Representative) said that it was difficult to find a substitute, and it was no use adjourning the case for that purpose. Mr. F. G. Curel, manager of the station, said that Brice was really a pupil; he had made every effort to get a substitute, but electricians were extremely scarce. None of the four men he had could take sole charge of the generating station; all of them worked seven days a week. A further two months were conceded.

Before the Oxfordshire Appeal Court, on December 12th, the City of Oxford Electric Tramways, Ltd., appealed for R. D. Price (33), unit adjustor. At a previous sitting the case was adjourned to allow the company to arrange with the Military authorities for the release of a man of 24, fit for general service, in lieu of Price, and it was now stated that the man of 24 had been passed for general service, and had joined up. Price was temporarily exempted for three months.

On the appeal of the Rochdale Corporation tramways department, conditional exemption has been given, on the recommendation of the Advisory Committee, to two motormen, aged 28 and 36.

Dry Cell with Gelatinous Electrolyte.—A rather ingenious solution for obviating the drying-out trouble of the electrolyte in dry cells, and the deterioration of the electrode even when on open circuit, is made the subject of a patent by Edward McGall and M. D. Malcomson, of Orange, N.J. It has been discovered that by using a colloidal gelatinous electrolyte of caustic soda and starch, the ordinary defects of dry cells are largely done away with, and that when, for example, zinc and oxide of copper are employed the efficiency of such cell is greatly increased, being, in fact, greater than that of a wet primary battery employing similar electrodes and an alkaline electrolyte. This is due, in part, to the starch grains or other particles of organic material in the colloidal solution apparently increasing the ionisation of the electrolyte whereby the capacity and conductance are increased.—*Electrical World.*

THE A.E.G. AND FUTURE EXPORT TRADE

One of the most remarkable facts brought to light in recent years relates to the grip which the leading electrical engineering groups in Germany have, or had, obtained in different parts of the world. Apart from the footing gained in British Overseas Dominions, which has probably now been largely removed, these groups have developed their sphere of activity in China, Japan, Mexico, and in practically all the Republics in South America. The direct export trade from Germany to oversea countries has been greatly facilitated by the formation of transmarine supply and tramway companies, which first expand into installation contractors, and then develop into general contractors, whether the machinery, plant and accessories are procured from Germany or elsewhere, or partly made on the spot. With these introductory remarks attention may now be directed to the future aims of the A.E.G., as disclosed by Dr. Walther Rathenau at the recent annual meeting, and although the observations specifically refer to this company, it is reasonable to apply them also to the Siemens-Schuckert Co. and the associated Siemens & Halske Co. in connection with their transmarine ramifications.

The principal subject discussed at the recent annual meeting of the A.E.G. in Berlin, as in certain former years, referred to the rate of dividend which was recommended for adoption. Several shareholders suggested that the accounts would permit of the payment, instead of the 12 per cent. then proposed, of a rate of 14 per cent., as paid in years of peace. In opposing this contention, Dr. Walther Rathenau is reported to have stated that without the possession of the undisclosed reserves, the undertaking would probably have suffered very severely in war time. The dividend rate was carefully examined by the directors, whose fees were fixed according to the rate, and who, therefore, had a great interest in the percentage. If, nevertheless, they exercised reserve in calculating it, that was not due to an ill-intentioned policy, or one of accumulating reserves, but it was based upon the construction of the undertaking. Those who were shareholders must know that they were interested in an undertaking which was certainly well established, but which entertained no chances for speculative development, and also had not the advantage of offering a surprise in dividends. As to the renewed wish for a higher dividend, the speaker proceeded to emphasise the dark side of the problem. He said that above £20,000,000 was invested in the undertaking, but a considerable portion of that was employed abroad in the form of branches, investments and credit both in neutral and hostile countries. The directors did not know at all how to value that capital. The business was international, and over 40 per cent. of the work was exported in times of peace. If the export trade after the war should be lacking, the buildings which served that purpose would be without employment. In order, however, to maintain the business, a large expenditure of work, energy, and, above all, of money, would be necessary. The reserve fund was provided for difficult times. Could it not, even once, happen that the company might not earn any profits? Then efforts would be made not to remain without any dividend.

Dr. Rathenau proceeded to state:—"We are a peace undertaking; that is characterised by a great ramification over all European and ex-European districts. The company is interested abroad through branch establishments, branch undertakings, credit and contracts; the transmarine, the international business in general, claims a considerable amount of our annual turnover. If we decided at the beginning of the war to undertake a very fundamental transformation of working, we did not conceal from ourselves the danger assumed by us that the question concerned the subjection of a portion of our property to great depreciation, and the exclusion of a considerable part of our regular business. We, nevertheless, resigned ourselves to this new form of business with enthusiasm, under the consideration that it is our duty, as a factor in German economy, to serve the country's defence, and place our workshops, machinery, and men unreservedly at disposal for the great common purpose. In this connection we have been led by the idea that this war is not a war of months, but extends over years. On reaching our decision considerable services were rendered by the fact that the reserves—just the reserves—made it possible for us to raise buildings and plant out of the earth, without the danger of touching our assets. The liquidity of funds, which is a costly luxury and which represents over £5,000,000 without employment, has contributed in this direction. The efficacy which the company developed is great. The question concerns over 250,000 sq. metres of supercial area which we built over; 30 hectares (74 acres) are roofed in, and the war contracts already run into nine figures.

Dr. Rathenau continued:—"Also, if one does not mistake the political and military situation, the feeling cannot be excluded that now, for the first time, after a long while, a light appears in the distance—a peace light—but this situation also cannot relieve us from our duties. We have also to continue to strengthen our equipment, even to create buildings and large new works, since it is known that the Hindenburg programme claims the whole force of the country—that through this mighty strain of labour Germany has become an arsenal." In conclusion, the speaker stated that "the auxiliary service law makes every one of us a soldier, and in this the A.E.G. has to play its part."

SOME NOTES ON WARRANTIES.

[From our Legal Contributor.]

Many manufacturers in different parts of the country are at the present time engaged in manufacturing and selling goods which are rather outside their own line. Consequently, it is the more important that they shall pay attention to the terms of the contracts which they undertake to fulfil. For instance, a man accustomed to manufacture and sell a particular kind of lamp will not concern himself about warranties of any kind; but when he commences some new manufacture, those whom he has to supply will probably bind him to the fulfilment of very strict conditions.

A large number of cases which reach the courts in relation to the sale and purchase of goods depend to some extent upon the question of warranty. Was a warranty given? Was there a breach of that warranty? These are questions of great importance to dealers in goods of all descriptions.

It is of the utmost importance that if a warranty is given, it is carefully carried out. A breach may lead to consequences the scope of which it is impossible to foresee.

At the same time, the machine, or whatever it is, can only be expected to do what is required of it if it is properly erected. If an accident happens owing to improper erection by the purchaser, the seller is not to blame.

In a case recently heard at Birmingham, a firm of engineers and founders in Coventry sued another firm of engineers in Birmingham to recover damages for alleged breach of warranty. The defendants had supplied a crane, to be placed on a cupola platform, to lift about 15 cwt. Soon after the crane was erected in its place, it fell over when carrying a weight less than it was warranted to carry, with the result that one unfortunate workman in the employ of the plaintiffs was killed, and the accident cost the plaintiffs over £200, paid under the Workmen's Compensation Act. To recover this sum the plaintiffs sued the defendants. It was alleged by the defendants that the crane was perfect in its construction, and that it fell owing to careless erection by the plaintiffs, and an undue strain upon a particular arm of the crane which was not placed on a level foundation. In this case there was an amicable settlement, but as to the question of breach of warranty, judgment was entered for the defendants.

A warranty need not necessarily be expressly given. If it appears by the contract that the buyer relies on the vendor's skill or judgment, and the goods sold are in the way of his business, the vendor is bound to supply goods reasonably fit for the purpose, and there is an implied warranty that they are so. For example: A shipbroker gave an order to the salesman of a coal merchant for bunker coal for a steamship, and said they had been using "B" coal, and the salesman said he could supply "S" coal, which ought to suit if "B" coal suited. Whereupon the broker gave the order for the "S" coal, which proved to be worthless for bunkering. It was held that the salesman's statement was tantamount to a warranty, and that the warranty had been broken (Crichton and Stevenson *v.* Love (1908), S.C. 818).

There is all the difference in the world between the kind of representation which is generally made to induce a sale and that which is a warranty in the strict sense of the term. Every seller extols his own merchandise. A. B. tells you his metallic filament lamps are the finest in the world. Go into C. D.'s shop next door, and his man behind the counter will tell you that C. D.'s lamps are the finest in the universe.

What a man says by way of commending his own goods cannot be twisted into a warranty. Nor is a mere expression of opinion a warranty so as to be part of the contract.

In a leading case the vendor put up a horse for sale by auction, and the plaintiff bought the horse for £280, relying on the positive assurance made to him privately the day before the auction that the horse was sound. It turned out wrong, and the purchaser sold it for a reduced price and sued the vendor for breach of warranty. It was finally held on appeal that what was said about the horse was representation only, and not a warranty, and that the vendor could not be held responsible for a misrepresentation, unless made fraudulently. An expression of opinion is not a warranty, and is not, therefore, a part of the contract. A buyer who proves a breach of warranty is not entitled to avoid the contract and refuse the goods unless there is an express stipulation to that effect in the contract.

It must be acknowledged that the distinction between a warranty and a mere representation is in some cases rather fine. It has been generally held that where a representation is shown by the evidence to have been intended to influence the buyer, and, in fact, was intended as a warranty which would be an essential part of the contract, it will be taken as a warranty, and where it was not reduced to writing the warranty, as a part of the contract, will be tested by the evidence showing whether or not the representation was made pending the sale, and subsequently accepted as a *bond-fide* warranty. An interesting illustration of the extent to which a guarantee and description contained in a trade catalogue will be presumed to be a warranty is found in the case of Williamson *v.* Rover Cycle Co. (1 W. R. 615). The plaintiff bought a machine from the defendants' agent which answered the description in their catalogue—which he read before buying—and there was in the catalogue an express guarantee that

the manufacturers had taken all precautions to secure good quality of material and workmanship, and that they guaranteed to make good any defects in these respects any time within a year. The plaintiff used the machine frequently, and at last, within a few weeks of the expiry of the guaranteed period, the steering part broke, the front wheel was detached, and the plaintiff injured. The plaintiff, after the accident, sent the machine to the manufacturers, who replaced the broken parts and threw them away. The plaintiff, relying on the warranty, sued the defendants and got a verdict for £120 damages. In the Divisional Court this decision was reversed and judgment entered for the defendants, and this decision was upheld by the Court of Appeal on the ground that the accident and the appearance of the broken tube were no evidence of any breach of warranty. Witnesses who had seen the broken part after the accident said it was a clean break, and not the result of defective material or workmanship. The defendants having replaced them and thrown them away, their non-production did not shift the burden of proof upon the defendants.

BUSINESS NOTES.

Book Notices.—The December issue of the British Westinghouse *Club News* is a "Blighty" number, published for Westinghouse men with H.M. Forces. It contains a number of amusing sketches and notes that will be very interesting to others besides those for whom they are written. Nothing in the issue is more timely than the picture of a sturdy British Westinghouse workman who is going to "Strike Hard in the Coming Year" at home, while his fighting comrades do likewise just across the Channel.

Calendars.—Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, have sent us another of their pocket diaries which we have found so useful in past years—"just the thing"—with handy tables and other technical information; and a desk blotter handsomely designed and finished in bronze, which cannot possibly conceal itself under a pile of papers, as does that elusive sheet of blotting paper, which is never there when it is wanted.

Messrs. Downes & Davies, of Stanley Street, Liverpool, have issued a calendar for 1917. It is a charming study of "Elaine," with the firm's name and a neat little set of monthly slips both unobtrusively placed.

Messrs. Grindlay, Ross & Co., Ltd., of 47, Waterloo Street, Glasgow, have issued a wall calendar for 1917, with monthly date slips.

From the Hart Accumulator Co., Ltd., of Marshgate Lane, Stratford, E., we have received a desk blotting pad for 1917, with the calendar for the year neatly placed on each sheet.

France.—La Compagnie Générale de Constructions et d'Applications Electromagnetiques is the name of a new company which has lately been formed at Pantin, near Paris, with a capital of £52,000.

Holidays.—The works of the Hoffmann Manufacturing Co., Ltd., Chelmsford, are closed until January 1st for holidays and stock-taking.

Bankruptcy Proceedings.—L. A. Thomson (trading as Saville & Walton, 39, Victoria Street, S.W., electrical engineers and contractors).—Trustee (Mr. E. S. Gray) released December 18th, 1916.

Trade Announcement.—Mr. T. A. Nunwick, of 4, Carr Street, Blackfriars, Manchester, has been appointed agent for Lancashire and Yorkshire by the Midland Electric Manufacturing Co., Ltd., of Birmingham, and will represent the firm from January 1st. This is in addition to the other agencies at present held by him.

LIGHTING AND POWER NOTES.

Aylesbury.—The responsible Ministry has informed the U.D.C. that it is unable to recommend the L.G.B. to agree to an application for sanction to a loan to give an additional supply to a local firm. The Council has decided to meet the case by laying a larger main at an estimated cost of £150, one-third of which is to be paid by the firm, together with not less than 25 per cent. of the total outlay for at least five years by current used; the price per unit is to be 1½d., with a special fuel clause. Lloyd's Bank, Ltd., has been asked to increase the electricity loans to £21,600.

Baildon (Yorks.).—E.L. Proposal.—The District Council has asked the Shipley Council if it will undertake to supply and distribute current in the Baildon area on the same terms as in Shipley. The Shipley Council has expressed its willingness to supply Baildon if terms can be arranged, and has instructed the electrical engineer to prepare an estimate as to probable consumption, and report to the next meeting.

Bolton.—Public Lighting.—With a view to minimising the increasing number of accidents, a conference of representatives of the Electricity, Gas, Tramways, and Watch Committees has decided to install electric lighting at points to be selected by the Chief Constable.

Bedford.—Proposed Extensions.—The T.C. has adjourned a recommendation by the electrical engineer to carry out certain extensions costing £34,076, including new turbine plant, mains, transformers, &c., with a view to supplying a large consumer outside the borough. A minimum revenue of £2,890 per year for five years was guaranteed, while the consumer had agreed to pay towards the cost some £5,119. The engineer pointed out that the existing turbine had saved 20 per cent. in coal, while the proposed 1,500-kw. set would save about £2,000 a year additional, and obviate the present need of falling back on older and less efficient plant to meet increasing demands.

Bradford.—Wages.—Many of the employés of the Bradford Corporation electricity department, through the National Union of General Workers, are demanding an increase of 10s. per week on pre-war rates of pay. The respective departmental Committees will first consider the demands, and make recommendations to the Special War Bonus Committee of the Corporation.

Brighton.—The Lighting Committee of the T.C. has decided to dispose of a 440-kw. Willans-E.C.C. set for £1,250. The set was purchased in 1897 for £4,788.

Burnham (Somerset).—Price Increase.—The Electricity Co. has informed the U.D.C. that the price of current has been increased from 5d. to 6d. per unit.

Chile.—Permission has been granted to Senores Francisco Undurraga and Ismael Jerez Diaz Valdes to utilise the waters in the Department of La Victoria for the production of electric power for lighting and industrial purposes.—*Board of Trade Journal.*

Colwyn Bay.—Year's Working.—The working of the Council's electricity department, for the year ended March 31st last, has resulted in a surplus of £1,216.

Continental.—Spain.—La Sociedad Electrica Rotena is the name of a company which has lately been formed in the Province of Cadiz, to establish a small central electric lighting station in the town.

East Ham.—The question of reconsidering the present scale of charges for electricity supply has been referred to the E.L. Committee.

Hirers of arc lamps whose contracts are in abeyance have been permitted to use them during the Christmas season at specified hourly charges.

Epsom-Ewell.—E.L. Proposals.—The Epsom R.D.C. has decided to waive the receipt of the necessary July notice by the Wimbledon T.C. and the South Metropolitan Electric Tramways and Lighting Co. in their application for prov. orders for E.L. at Cuddington, and Cuddington and Ewell respectively. The view taken is that it would be a great help to Ewell to have a supply of current from a large central station like the County of London station.

The Epsom U.D.C. has decided to apply to the B. of T. and the R.D.C. with a view to obtaining protection in respect of the order of 1912, under which the Council is authorised to supply premises in Ewell with electricity.

The Ewell P.C., after considering the matter, has decided to submit the following resolution to the B. of T., and to ask for a deputation to be received on the subject:—"That the Ewell Parish Council is strongly in favour of a cheap and efficient supply of electricity being installed at the earliest possible moment. It is, furthermore, of opinion that one of the greatest needs of rural parishes in the South of England is cheap and reliable power. This would do more than anything to keep the village industries alive."

London.—St. Pancras.—The Electricity Committee, in view of the restriction of materials, has decided that until such time as the King's Road new plant is in operation, no application for current other than for national purposes will be entertained, other than where tenants take over premises already equipped.

Kensington.—The General Purposes Committee has consented to an application by the Kensington and Knightsbridge E.L. Co., for the raising of the charge for electricity for lighting (*i.e.*, 5d. per unit). Similar applications by the Notting Hill Co. were granted in 1915 and 1916, and it was therefore agreed to raise no objection to this company increasing the price to 5½d. per unit after the December quarter, and until June 30th, 1917.

Londonderry.—Proposed Loan.—The T.C. has authorised an application for sanction to a loan of £4,700 in connection with the electric light and water extension schemes, the estimate having been exceeded owing to the increased cost of machinery.

Manchester.—The Corporation electricity department set up a record one day last week, over 800,000 units being consumed during the 24 hours.

Southampton.—The Borough Electrical Engineer has drawn the attention of the Council to the flooding of the mains on the Western shore; also to the difficulty of getting spare machinery parts—a particular case being steel spindles for the coal conveyor which are subject to excessive wear. A satisfactory increase in

load on the station has occurred, this now approximating that of the winter before the war.

Further boiler plant will be required before or when the lighting restrictions are removed, and consent is to be asked for this new plant.

The T.C. is to place an order with the Chain Belt Co. for an elevator to be installed for a new coal bunker. The price is approximately £76.

Southend-on-Sea.—PROPOSED PLANT EXTENSION.—The electrical engineer reported that the capacity of the existing plant at the generating station and in the battery room at Chalkwell Park was 3,220 KW., and that in his opinion the demand upon the plant would at the termination of the war, and when the lighting restrictions had been removed, amount to approximately 3,800 KW., in addition to which a margin of 500 KW. would be necessary as a stand-by, and that consequently it would be necessary to take into consideration at an early date the desirability of acquiring two 750-KW. steam generators which could be installed in the existing floor space available, thus avoiding the expense of carrying out extensions to the engine room. The Electric Lighting Committee has referred the matter to a sub-committee for consideration and report. A recommendation by the Highways and Works Committee that notice be given to the Southend Gas Co. to determine the existing agreement for public street lighting was rejected by the Council.

TRAMWAY and RAILWAY NOTES.

Birmingham.—TRAMWAY STOPPAGE.—On Friday last, owing to the bursting of a steam pipe at the Nechells temporary power station, the whole of this plant was shut down temporarily, and as a result the tramway service was again suspended during two short periods of the morning.

Bradford.—WAGES.—In connection with the negotiations already proceeding in the tramway department for advances in the wages and revision of conditions of work of certain classes of workers, the Tramways Committee met again last week on the matter, and resolved that drivers who have not received an advance since the commencement of the war be granted ½d. per hour advance, and that all other male employés of the traffic staff (including drivers and conductors) be granted ½d. per hour increase, irrespective of scale advances, as a special war wage, on account of the increase in the cost of living. Overtime is to be paid for at the rate of time and a half, either on the seventh day or over the normal time on other days. The men's demand was for 1d. advance.

Continental.—SPAIN.—The Sarria-Las Planas section of the new electric railway of the Compania de Ferrocarriles de Cataluna, to connect Barcelona with Tarrasa, has lately been completed and opened for traffic.

A concession has been granted to Messrs. Chavarri Petremont and Co. for the construction and working of an electric tramway for goods traffic, from the station of Miravalles (on the Castijon-Bilbao Railway) into the town.—*Board of Trade Journal.*

Chile.—A decree has been published granting to Don Eduardo Heyraud permission to construct and work an electric street railway between Santiago and Reuca; the line will be of metre gauge, and approximately 8 km. in length.—*Board of Trade Journal.*

Rochdale.—The Tramways Committee attributes the recent fatal accidents on its system to the dark condition of the streets, and the manager is to approach the Chief Constable with a view to some improvement, either in the lighting of the cars or of the streets on the main car routes.

Shipley.—The abstract of accounts for the year ended March 31st last, issued last week, shows that all the trading undertakings have made profits—even the gas department having converted a former loss into a profit, owing to advanced prices. The only contributories to relief of the rates, however, were the tramway department, £574, and the water department, £729.

Southampton.—EFFICIENCY (?) OF FEMALE LABOUR.—As a result of the ticket stock-taking for the year ended March 31st, 1916, it was found that tickets of the face value of £408 were unaccounted for. It was thought at first that a mistake had been made on the previous stock-taking, but after full investigation the tramway manager states that he is bound to arrive at the conclusion that the discrepancy is accounted for by the transition from male to female employés. They first adopted the system of women conductors in August, 1915, and practically at the same time the entire ticket-office staff was replaced by girls. Owing to the work being intricate, and in many cases far beyond the understanding of the women conductors taken on at that time, mistakes in booking were extremely frequent, and were not always detected by the new and inexperienced ticket-room staff. In his (the manager's) report of February, 1916, regarding the control of the office staff, he made special reference to the state of chaos which existed in the ticket room up to that time. Girls were much more careless about losing tickets than the men were, although this fault has been greatly remedied of late by adopting stern methods A ticket error book has now been adopted, which automatically prevents error through this cause. Another point is that a great number of tickets were used in the women's training room, and at one time a large number of these were taken from stock and not booked up. Before the ticket error book was inaugurated, conductors undoubtedly accidentally kept packs of tickets out instead of paying them over at night. This may have resulted in many packs being missing during the stock-taking, and possibly next year when stock is taken a large number of the tickets short may be found. The manager is absolutely satisfied that there has been no monetary loss in this connection, and that the shortage is purely a paper one.

Southend-on-Sea.—Application is to be made to the B. of T. for permission to use double-decked tramcars upon the light railways in the borough. In view of the difficulty of securing the necessary material required for maintaining the tramways, the electrical engineer has been authorised to purchase parcels of any material required, subject to the sanction of the chairman.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—SYDNEY.—January 22nd. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

February 19th. Municipal Council. Meters, maximum demand indicators, feeder regulators. Specification from E.L. Department, Town Hall.

PERTH.—January 10th. P.M.G.'s Department. Telephone instruments and parts. See "Official Notices" December 15th.

MELBOURNE.—January 31st. Department of the Navy. Dynamos, switchboard, motors, balancers, and control gear, for Flinders Naval Base. Specifications from the Director of Naval Contracts, Melbourne.

March 5th. Corporation. One 7,500-K.V.A. turbo-alternator. Specification (21s.) from the Town Clerk.

Bootle.—Corporation. Tramway rails. See "Official Notices" to-day.

Leith.—January 3rd. Electricity Department. 6,000 tons of washed singles during six months from January 15th, and (alternatively) 12,000 tons of washed singles during 12 months from January 15th. Burgh Electrical Engineer, Great Junction Street.

New Zealand.—DUNEDIN.—January 24th. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

TAURANGA.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime and Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

Spain.—The municipal authorities of Astorga (Province of Leon) have recently invited tenders for the concession for the electric lighting of the town during a period of 15 years. Tenders have also been invited by the municipal authorities of Pedreguer (Province of Alicante) for the electric lighting of the town for two years.

West Ham.—January 11th. Corporation. One water-tube boiler, one 3,000-KW. turbo-alternator. See "Official Notices" to-day.

Wigan.—January 8th. Tramways Committee. 30-H.P. motor tower-wagon. Mr. Frank Buckley, General Manager, Market Place.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Australia.—P.M.G.'s Department, N.S.W.:—

Additional automatic telephone apparatus, £1,151.—Automatic Telephones (Aust.), Ltd.

30,000 jointing sleeves, £236.—Western Electric Co. (Aust.), Ltd.

N.S.W. Public Works Department:—

The tender of Harvey & Phillips, originally accepted for the supply of 16 D.C. motors and equipment (see ELEC. REV., December 15th), has been annulled, and the contract awarded to Warburton, Franki, Ltd (Electric Construction Co.), £3,948.

Department of Defence:—

Installation of 18 intercommunication telephones at Victoria Barracks Melbourne, £189.—T. Draper & Co.

Victorian Railways Department:—

Signal lighting transformers for power signalling.—Aust. Gen. Electric Co.

Half-watt lamps, lanterns and globes.—Aust. Gen. Electric Co.

—*Tenders.*

Government Contracts.—In the list of War Office contracts announced in our last issue, for the name *Bristol* Ebonite Co Ltd., read *British* Ebonite Co., Ltd.

Ilford.—U.D.C. Coal for the Electricity Department for four months :—

Bradbury, Son & Co., Ltd.—Tamworth small nuts, 50 to 60 tons per month, at 25s. 1d. per ton.

E. Foster & Co., Ltd.—West Cannock D.S. nuts, ¾ in. to 2 in., 50 tons per month, 27s. 10d. per ton; also 20 wagons East Cannock 4 ft. 1½ in. nutty slack, 21s. 4d. per ton.

Oakley, Sollas & Co., Ltd.—Nailstone 1½-in. main nutty slack, 100 tons per month, 20s. 3d. per ton.

London.—St. Pancras.—Owing to a fire at the Newdigate Colliery, the B.C. has had to buy other classes of coal.

Rawtenstall.—Corporation. Additional switch-panels at the electricity works, Hareholme : British Westinghouse Co.

VARIABLE-SPEED GEARS FOR MOTOR ROAD-VEHICLES.

By ROBERT E. PHILLIPS.

The following is an extract from a paper read before the Institution of Mechanical Engineers, on the above-named subject :—

Electric Transmission.—Electric systems, or, as they are more properly designated, petrol-electric systems, owing to the prime movers employed being of the internal-combustion type, may be conveniently divided into four groups :—

1. In which the surplus power of the engine is stored in the form of electric energy in a battery of accumulators and is given out when required to augment the power of the engine, of which the Pieper or Auto-Mixte may be taken as an example.

2. In which the entire power of the engine is converted into electrical energy, which is absorbed continuously by an electric motor driving the road wheels of the vehicle, of which the Stevens may be taken as an example.

3. In which electric energy is employed to start and accelerate the vehicle, after which the drive from the engine to the road wheels is transmitted through a magnetic clutch, of which the Germain may be taken as an example.

4. In which the electric energy is wholly or partially employed to start and accelerate the vehicle, after which the electric drive is cut out and the power is transmitted to the road wheels mechanically, of which the Thomas may be taken as an example.

Although it may well be argued that each is best adapted for a particular class of work, there is no gainsaying the fact that the second system is the only one which has been used on a commercial scale for any considerable length of time. Dealing, however, with these systems in their numerical order, the points in favour of the first system are that the surplus power of the engine is being continuously stored in the form of electric energy which is available for use when the power of the engine requires to be augmented, and that the engine and dynamo run at a constant speed, which enables the former to be run to the best advantage and enables the latter to produce a current of suitable voltage to charge the accumulators at the proper rate.

The points in favour of the second system are, first, its simplicity, as the whole of the power of the engine is converted into electrical energy, which is transmitted direct to the motor driving the road wheels; secondly, the small number of its parts; and thirdly, as the speed of the engine is independent of that of the vehicle it can be run at the speed at which it gives its maximum power and efficiency. It is claimed for the Stevens transmission that the over-all commercial efficiency running in normal omnibus service is 79 per cent., and that this efficiency arises chiefly from the great economy both in petrol consumption and in general upkeep. The factors which make for economy in petrol consumption are the slow speed of the engine as compared with the speed of the transmission shaft, and the ability of the vehicle to free-wheel, *i.e.*, run without propulsion, for a considerable part of its running time; while the factors which make for economy in upkeep are : (1) The simplicity of the transmission, in which no gear-wheels, no clutches, and no battery are employed; (2) the absence of transmission stresses due to the elasticity of the electrical drive; (3) the absence of clutching and de-clutching as obtains in mechanical gearing; and (4) the non-breaking of any electrical circuits during driving. This system has been used in the Tilling-Stevens omnibuses and other public service vehicles for several years. In the London service alone these omnibuses have run over 6,000,000 miles at an estimated cost of 7.132d. per mile; while in the running of over 3,000,000 miles on solid rubber tires in the London service of omnibuses an average of 20,148 miles per tire has been obtained.

The advantages claimed for the third system as compared with the first or second systems are, first, that when the load is within the capability of the engine the drive between the engine and the road wheels is practically, though not absolutely, mechanical, at which time the electrical losses are reduced to a minimum; and, secondly, that the mechanism can be used for braking purposes. Against these, however, is the serious drawback that mechanical means has to be employed for the reverse, in addition to which the double commutator adds to the complication of the control. It is also claimed for this system that as the electrical equipment is used solely, or mainly, for starting and accelerating, the equipment can be made comparatively smaller, lighter, and cheaper; but this would seem to be a fallacy, as the output of the electrical equipment cannot be confined to starting and accelerating duties only, for the simple reason that occasions must arise when more power than can be obtained on the direct drive will be called for, thus making it necessary to use the electric transmission. As this is the most severe duty that the electrical equipment can be called upon to perform, it must be of such proportions as will propel the vehicle during the whole working period without overheating if trouble is to be avoided.

As regards the fourth system, this is considered more economical than a direct electrical transmission, but against this must be set off the complications which arise from the introduction of the planetary gear and the clutches. The Thomas transmission has undergone two trials under the auspices of the Royal Automobile Club. The first trial was with a 36-h.p. Leyland lorry over a distance of 2,008 miles, the running being continuous day and night. The weight of the lorry unladen was 4.502 tons, and the weight of the load, including passengers, 3.181 tons, making a total of 7.683 tons. The running speed was not to exceed 12 miles per hour, and averaged (running time only) 10.47 miles per hour; the fuel consumption worked out at 7.555 miles per gallon, giving 58.046 ton-miles per gallon calculated on the gross weight and 24.030 miles per gallon calculated on the net load. During the trial no work was done upon the transmission with the exception of lubrication, for which 5½ oz. of oil were used, and at the end of the trial the whole of the transmission, with the exception that the teeth of the double helical planetary wheels were somewhat worn, and two brushes, four sparking tips, and one brush contact point were sufficiently burnt to require renewing, was in good condition. The second trial was with a 12-16-h.p. Delahaye car from London to Edinburgh and back, in which test the fuel consumption was approximately 35 miles to the gallon, giving 67.9 ton-miles per gallon. An omnibus fitted with this transmission and running in a regular service in London has given from 10¼ to 11 miles per gallon of fuel. It would therefore seem that the claim that this system is more economical than the direct electrical system is well founded.

Petrol-electric systems are without doubt handicapped as compared with the sliding type of change-speed gears—at all events, for use in pleasure and light commercial vehicles—first on account of excessive weight, and secondly on account of lack of power of rapid acceleration. As regards weight, it does not appear possible to make this compare favourably with the mechanical types of variable gearing without seriously risking its efficiency, and even breakdown under severe duty. With respect to acceleration, it must be borne in mind that sudden acceleration of the engine—which in a purely mechanical transmission is at once transmitted to the road wheels—only results, in a petrol-electric system, in an increased generation of electricity in the dynamo, which is followed later by increased speed of the electric motor as the magnetic flux is built up in the generator, and therefore an appreciable time elapses before the current has had time to make its influence felt at the road wheels. For heavy commercial work neither the increased weight nor the sluggishness in acceleration is a matter of much serious moment, and the latter defect may even be a blessing in disguise, as it affords a means of cushioning any shocks that may be set up in the transmission system by unskilful or careless driving. As petrol-electric systems allow of maximum acceleration without subjecting any part of the vehicle to undue strain, they have, as compared with mechanical gears, the great advantage that it places the most incompetent driver on a par with the most experienced and careful driver using a mechanical gear, and it is questionable whether—at all events for commercial work—the inability to accelerate rapidly is not more than compensated for by the saving in wear and tear arising from absence of shocks and undue strain.

Comparing petrol-electric transmission with hydraulic transmission, there does not seem to be much between them on the score of being noiseless, of not being affected by the distortion of the frame of the vehicle, and of giving a smooth acceleration and retardation. Theoretically, each seems to be an ideal transmission for motor road-vehicles.

French National Laboratory of Physics and Mechanics.—The Académie des Sciences has resolved to establish a National Physical and Mechanical Laboratory, for the purpose of scientific research directed towards industrial uses. The Laboratory will be controlled by a Council, of which half the members will be nominated by the Academy, one-fourth by State Departments, and the remainder by the chief industrial associations. The executive control will be in the hands of a small technical Committee. Existing laboratories engaged on similar work will be affiliated to the National Laboratory, and will work in close relationship with the latter. Substantial funds will have to be provided for the working expenses of the Laboratory, and for the assistance of the affiliated institutions.—*Génie Civil.*

NOTES.

Electric Lighting Provisional Orders.—The following is the official list of applications for Provisional Orders deposited with the Board of Trade on or before December 21st, 1916, under the provisions of the Electric Lighting Acts, 1882 to 1909 :—

Title of Order and description of area.	Name of promoters.	Agents.
Clayton and Queensbury	Electrical Distribution of Yorkshire, Ltd.	Torr, Durnford and Co., 2, Millbank House, Westminster, S.W.
Epsom Rural District (Extension). The Parishes of Cuddington and Ewell in the Rural District of Epsom.	South Metropolitan Electric Tramways and Lighting Co., Ltd.	Rees & Freres, 5, Victoria Street, S.W.
Featherstone, Garforth, Horbury, Luddenden Foot, Otley, Penistone. Rawdon and Yeadon, and Wortley.	Electrical Distribution of Yorkshire, Ltd.	Torr, Durnford and Co. (as above).
Wimbledon Electric Lighting (Extension) Order. The parish of Cuddington in the Rural District of Epsom.	Corporation of Wimbledon.	Lees & Co., Palace Chambers, Bridge Street, Westminster, S.W.

Volunteer Notes.—FIRST LONDON ENGINEER VOLUNTEERS.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, January 1st.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25. Lecture on "Telephones," 7.30.

Tuesday, January 2nd.—School of Arms, 6—7. Lecture, 7.15, "Street Fighting," by Company Commander Hynam.

Wednesday, January 3rd.—Instructional Class, 6.15. Platoon Drill, No. 1 Platoon.

Thursday, January 4th.—Platoon Drill, No. 7 Platoon. Ambulance Class, 6.30.

Friday, January 5th.—Technical for Platoon No. 10, at Regency Street. Squad and Platoon Drill for Platoon No. 9. Signalling Class. Recruits' Drill, 6.25. Lecture on "Telephones," 7.30.

Saturday, January 6th.—Commanding Officer's Parade, 2.45 (uniform), for drill in Battersea Park.

Sunday, January 7th.—Entrenching at Otford. Parade, Victoria (S.E. & C.R. Booking Office), 8.45 a.m.

(By order) MACLEOD YEARSLEY, *Adjutant.*

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the December meeting of the Association, Mr. Geoffrey Porter, borough electrical engineer to the Corporation of Worthing, was re-elected president for a second year. Messrs. R. W. Lyle (Messrs. Hoffmann Manufacturing Co., Chemsford) and W. Fennell (St. Albans) were elected members of the General Committee, and Mr. Percy Still (Chelsea) was re-elected as honorary secretary.

The total membership of the Association to date is 79, being an increase of 31 Diesel engine users during the year. The total horse-power represented by the Association has doubled during the year, being now 46,108 B.H.P.

A considerable amount of attention has been given during the year to the subject of the use of tar oils as fuel in Diesel engines. Several members of the Association have already commenced to use tar oils in their Diesel engines, either with a pilot ignition apparatus fitted to the engine, or without, and a considerable amount of useful experience has been obtained in the use of this class of fuel. Further trials are still being made, and certain difficulties have to be met, but there appears to be no doubt that if such fuel can be supplied to a suitable specification in various parts of the country at a reasonable price, Diesel engine users will soon make the necessary arrangements for its use, either wholly or partially, in place of the imported product.

The Committee's report on "Air-Compressor Explosions and Troubles" has been issued in pamphlet form, copies of which can be obtained from the honorary secretary.

Mr. Elliott A. Evans will, at the meeting next January, read a paper on "Chemistry and Examination of Lubricating Oils."

Information and particulars concerning the Association can be obtained from the honorary secretary, Mr. Percy Still, 19, Cadogan Gardens, London, S.W.

Physical Society of London.—At the meeting held on November 24th, a paper "On the Measurement of the Thomson Effect in Wires," was read by Mr. H. R. Nettleton. The paper describes how absolute measurements of the Thomson effect may be made in wires. The theory is fully worked out, and the sources of error likely to arise—especially owing to the smallness of the area of cross-section—are considered. The method is sensitive, consistent, and very rapid; its ultimate object is to determine the Thomson effect at different temperatures in a number of metals, both rare and base, at the same time, and with the same specimens, finding their thermo-electric powers. The preliminary experiments of this paper, testing the method, are with constantan wires of different lengths, with manganin, and with German silver.

A paper "On the Thermo-Electric Properties of Fused Metals," by C. R. Darling and A. W. Grace, was read by the former. One of the authors has for some time been investigating the possibility of using base metal thermocouples at temperatures above the melting point of one of the constituents. For this purpose it was necessary to determine whether any peculiarities in the thermo-electric behaviour of metals occur at fusion. In the case of lead, tin, zinc and cadmium there is no perceptible break in the continuity of the curves obtained. In couples containing bismuth, however, several cases were noted in which the E.M.F. remained constant for a wide range of temperature after the fusion of the bismuth. This occurs with silver, aluminium, iron, or nichrome as the other element. Useful applications of this property are discussed.

Appointments Vacant.—Assistant electrical engineer (£360) for the Government Electric Light Department, Federated Malay States. For particulars see our advertisement pages to-day.

Metropolitan Water Board Employes.—The *Times* states that the Board has adopted increased scales of pay for workmen employed in the Engineers' Department, fitters and electricians being among those affected.

Moscow and Co-operative Electricity.—Recently, in connection with fuel supply difficulties of industries in the central district of Russia, including Moscow, an interesting project has been proposed for constituting a large central electrical station to supply the factories and works with motive power on a co-operative basis. A report on the question, drawn up by the Association of Manufacturers and Works of the Moscow industrial region, states that the Moscow industry has to regard dearness of fuel, not as a passing phenomenon connected with the war situation, but rather as a permanent factor, even after the war. Certainly cheap petroleum cannot be expected, and almost as little may one expect cheap coal. The only sort of really cheap fuel that would be constant in price is peat. With centralised production of electrical energy, the current would be delivered at distant points as required. The question is only one of choosing a site for the central station and the selection of fuel. The choice lies between Donetz coal and peat. With Donetz coal the station might be constructed close to Moscow. With peat, on the other hand, it would be more profitable to construct the station on the marsh, as a good extensive peat marsh is to be found at a distance from Moscow of 120 to 140 versts. The cost of peat fuel will be one-half that of Donetz coal, even under the most favourable conditions for the latter.

Just recently, as a result of an agitation amongst some Moscow industrialists, energetically supported by the Association of Works and Factories, the question of establishing a central electrical station on a co-operative basis has made considerable progress; and not long ago, at a preparatory meeting, representatives of industrial concerns were invited to take part in the formation of an association called "Electro-Co-operative." This meeting took place on the premises of the Manufacturers and Works Association of the Moscow District, with N. I. Gutchkoff presiding. M. U. P. Jozhom acquainted the meeting with the history of the question. The idea arose two years ago, when the question of liquidating the 1886 Electric Light Co. was debated. The Association of Manufacturers and Works of the Moscow Industrial Region addressed in the year 1914 a report to the Ministry of Trade and Industry, in which was shown the importance to the Government of facilitating the supply of electrical energy to local industry, and the analogy of electric power to steam power for the railways.

The proposals in the report met with the complete sympathy of the Ministry, and there the working out of a corresponding project of law was warmly taken up; it is now completed, and has been placed before the Council of Ministers, and in the shortest possible time legal effect will be given to it. It is proposed to publish a supplementary regulation which will provide for a compensation per verst for the right of alienating land and using the ground, where cables are to be laid and posts erected.

The proposed Electro-Co-operative should of itself bring about a mutual alliance of the industrial concerns requiring electrical power. Trading in electricity for the purpose of extracting profit is not included in the objects of the promoters. Therefore only a surplus above the Co-operative's requirements can be delivered to manufacturers who may not be included in the Co-operative Association. Calculations show that the capacity of the plant should be 30,000 H.P.

Linking-up Electricity Stations.—A meeting, convened by Mr. W. J. Bache, borough electrical engineer of Cheltenham, was held at Bristol on December 18th to consider the question of linking-up electricity works in the West of England area. It was decided to form a general committee, with Mr. F. H. Corson, of Gloucester, as chairman, and Mr. Bache as vice-chairman and secretary, and a working sub-committee was also constituted.

Fatalities.—LONDON.—On December 20th, at the City Coroner's Court, Mr. Walter Schroder held an adjourned inquest on Emily Booth, aged 19, lift attendant at 5, Newgate Street, City, who was fatally crushed in an electric lift there. She had been employed for about a month by Messrs. Vicars & Poirson, art needlework manufacturers. On the day in question she had brought a junior clerk down from the fourth to the third floor, where she was to have waited. The lad had scarcely left the lift, however, when the cage suddenly ascended, and Miss Booth, in attempting to jump out, was pinned between the floor of the lift and the ceiling above. Engineers and carpenters had to be called in, and nearly an hour elapsed before the girl could be extricated,

She was dead. At the first hearing, Mr. John Tomlinson Corbin (Price & Belsham), a lift engineer, of 52, Queen Victoria Street, said his firm had had charge of the lift for 10 years. It was worked by electricity, controlled by a lever in the cage. Witness thought the only explanation to be given for the accident was that the deceased was standing near the switch, and unconsciously moved the handle.

When the case was resumed, Mr. Thomas William Corbin, an electrical engineer of the same firm, stated that on Tuesday, last week, he visited the premises, and found the lift exactly as it had been left after the accident. In conjunction with a representative of Waygood-Otis, he examined the lift, and found a leakage of electric current to earth, the result of the leakage being that the lift would move without the handle being operated, and while the door was open. His opinion was that the lift would move at once, and that the leakage occurred just at the time of the accident. That was not a thing that could be guarded against, and the person having control and knowledge of the working of the lift would not recognise it until the accident happened. If the deceased had remained standing in the centre of the lift she would have been quite safe.

By Mr. Verney (H.M. Inspector); He located the leakage close to the control handle, and stripped off the metal tubing in which the wires were fitted, and there discovered the leakage. It occurred at a point where the tube went round a sharp corner. In that bend one of the wires had become bared, and was touching the tubing, and so was earthed. The wires did not move in the ordinary sense of the term, but he imagined there was a little vibration every time the lift moved. He saw no reason why they should move, and, in his opinion, the break was not there when the lift was originally fitted up. A long-continued, but slight, vibration would account for the break. He thought the abrasion of the outer covering had probably been going on gradually for years. He did not think it should have been manifest in the working of the lift, and it was probably made manifest for the first time when the accident occurred. He thought the wiring was properly arranged. As an expert, he did not think the controlling handle came into the question of the accident at all. The deceased's body got in the position in which it was seen because the gate was open.

Harold Gates, chief engineer to the previous witness, said he had never heard of a similar accident to a lift. Quite recently this lift had stopped owing to a dirty contact, which was remedied in a few minutes.

Mr. John T. Corbin, recalled, said that Messrs. Vicars had always given him full instructions to do anything necessary at any time. There was nothing to suggest any defect in the insulation. Witness was present at the inspection on the Tuesday, and he agreed with his brother's evidence.

Mr. Charles H. J. Day, a director and engineer of Waygood-Otis, Ltd., said the lift was put in by his firm 14 years ago, but they had had nothing to do with it for 10 years. He had seen what had been discovered, but he did not think there was a means of detecting the defect by ordinary observation, the wires being in a steel tube, and beyond the range of vision. He did not know how such a thing could be provided against. He did not think an insulation test would be infallible, although it might show it. He agreed that if the girl had remained standing in the cage she would have been safe, as the lift would have stopped almost level with the top floor, and quite clear of the buffers. If an insulation test were made, a fault might occur an hour or two afterwards. The test might reveal a weak spot.

By Mr. Verney: He did not agree with the witness as to vibration, which would be absolutely infinitesimal. He thought the defect had been suddenly produced. He hardly thought the wiring was defective when it was put in, because it had stood for 14 years. There was certainly no indication to show that the lift was out of order.

The jury returned a verdict of "Accidental death."

Dublin.—At an inquest on the body of Patrick Davis, 28, electrician, employed by the Great Northern Railway Co. of Ireland, at the Amiens Street terminus, Dublin, the evidence showed that he had been found fatally injured lying between the rails at the station after the departure of a train for Howth. Mr. Bannerman, station-master, said it was not customary for an electrician to go under a train before it started, and he did not know what deceased could have been doing there. The engine driver of the Howth train, Patrick Rice, said if anyone was working under the train, he should have got notice of the fact, and a red flag should have been hoisted. He received no notice, and saw no flag. John Stanley, electrician, said he told Davis about a defective light in one of the Howth carriages, but he did not know that he had gone to work under the train. John McWilliam, foreman of the train-lighting department, deposed to the precautionary measures taken when electricians were at work on trains. A red flag should be used, and in the event of an engine being attached to a train the man should warn the engine driver and have a look-out man. There were 10 electricians employed, but there were no persons specially employed as look-out men. In 21 years' experience, witness had never known of an accident of this kind until now. Mr. A. W. Whieldon, engineer, working under the locomotive engineer, said a man working under a train must take precautions to see that he was protected. It was not sufficient merely to tell the foreman or charge hand. The foreman could not supervise every case. Witness had made a quarter of a million inspections, and that was the first accident in 21 years. The Coroner (Mr. Fiery) said he considered the company had been guilty of negligence in not seeing that the regulations were carried out. The jury returned a verdict that death resulted from shock and hæmorrhage, and added a rider that "there was want of supervision on such dangerous work."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—The General Purposes Committee of St. Pancras B.C. has adopted a recommendation of the Electricity Committee that the salary of Mr. T. W. Merry, superintendent at the King's Road electricity station, be increased from £208 per annum to £233 per annum, and further increased a year hence to £250 per annum. In October last Mr. Merry submitted an application to the chief electrical engineer asking for permission to apply elsewhere for a post of electrical engineer which was vacant, and, after consultation with his chairman, the chief electrical engineer replied that he was unable to release him, but promised to recommend an increase of salary. Mr. Merry has been in the service for over 16 years, and has been in receipt of his present salary of £208 per annum since March, 1910. Since that date the output from the generating station under his direct supervision has increased from seven million units to this year's output of about 12 million units. The chief electrical engineer states that Mr. Merry has put in a considerable amount of time at the works on Sundays and after normal hours, particularly since the war, as the plant under his control is much overworked and requires constant skilled supervision at all hours for its repair and maintenance; that he has proved himself a very capable assistant, and, under his supervision, the plant has been maintained in a high state of efficiency. The following salaries paid by other boroughs for a similar position were submitted, namely:—Hammersmith £300, Woolwich £280, plus house, coal, and light, Leyton £250, Stepney £240, plus house, coal, and light, and East Ham £240.

Mr. Claude R. Marshall, chief assistant engineer at the North Metropolitan Electric Power Supply Co.'s St. Albans undertaking, has been granted leave of absence, and permission to accept a commission in the Inland Water Transport, Shipping Section, of the Royal Engineers.

The Rochdale Electricity Committee have granted a further month's leave of absence to Mr. C. C. Atchison, the borough electrical engineer, who is still away owing to a breakdown in health.

The Southampton Tramways Committee has increased the salary of the manager, Mr. W. T. Robson, from £400 to £500 per annum.

The salary of Mr. H. W. Miles, assistant accountant, Southampton electricity department, is to be increased from £210 (which includes £10 war bonus) to £225 by increments of £10 and £5. The salary of Mr. B. Horne is to be increased from £99 to £115 (which includes war bonus). In the event of war bonuses being stopped at any time, the maximum salaries in these cases will be £225 and £100 respectively.

Doncaster Tramways Committee has appointed Inspector Fuller as chief inspector, vice Mr. Baker, appointed to succeed Mr. Strachan as traffic superintendent.

General.—Mr. A. H. Norway will resume his duties in the General Post Office, London, on January 1st, on the expiration of his period of appointment as Secretary to the Post Office in Ireland. The Postmaster-General has appointed Mr. J. MacMahon to succeed him in Dublin.

Roll of Honour.—The Meritorious Service Medal has been awarded to Lance-Corporal J. G. L. Green, R.E., for services rendered in France. Mr. Green was with Messrs. Page and Miles, Ltd., electrical engineers, Brighton.

Private Ernest Mason, North Staffs. Regiment, who was in the electrical department of the North Staffordshire Railway, is reported missing.

Private J. Newstead, London Regiment, who has fallen in action, was an employé of the Telegraph Construction and Maintenance Co.

Lance-Corporal H. Mayes, Oxford and Bucks Light Infantry, of the B.T.H. Co., Ltd., of Rugby, has died of wounds.

Mr. C. Linford, formerly employed in the St. Pancras electricity department, has died of wounds received in action.

Private J. Prince, of the Lancs. Fusiliers, killed in action, was employed by Messrs. I. Frankenburg & Co., Salford.

Private A. Jackson, Cheshire Regiment, attached to the Machine Gun Corps, has been killed in action. He was employed by the British Westinghouse Co., Trafford Park.

Private G. Lewis, Lancashire Fusiliers, killed in action, was employed at the Salford Corporation electricity works.

Lance-Corporal E. Latham, of the Loyal North Lancashire Regiment, of Preston, who has been recommended for the Military Medal, and is in hospital suffering from wounds, was employed by Messrs. Dick, Kerr & Co.

Private B. Parr, North Staffs. Regiment, who enlisted whilst with Messrs. Taylor, Tunnicliffe & Co., Ltd., electrical fittings manufacturers, Hanley, is reported missing.

Obituary.—Mr. Arthur James Ireland.—After a brief illness, Mr. A. J. Ireland, of the British Thomson-Houston Co., Ltd., Rugby, died on the 22nd inst., aged 57. Mr. Ireland had a very wide circle of friends in the electrical industries.

Mr. Harry L. Davis.—The death took place on December 20th of Mr. Harry L. Davis, of Brockley, S.E., who was for 42 years with the Telegraph Construction & Maintenance Co., Ltd. He was in his 59th year.

Mrs. Jane Davidson Callender.—We regret to note that Mrs. Jane Davidson Callender, widow of William Ormiston Callender, founder of the well-known business now known as Callender's Cable & Construction Co., Ltd., passed away at Bournemouth, on December 22nd, in her 90th year.

CITY NOTES.

India-rubber, Gutta-percha, and Telegraph Works Co., Ltd.

The annual meeting was held on December 20th, at 106, Cannon Street, E.C. Major Leonard Darwin, the chairman, first referred to the loss of their cable-ship *Dacia*. Although an old ship—she was built in 1867, and acquired in 1872 from Sir Charles Bright, the pioneer of Atlantic telegraphy—she was still a valuable vessel for her work, the cable machinery being as good as, if not better than, that of any cable-ship afloat. In her time she had laid cables in the West Indies, on the coasts of Chile and Peru—in that voyage she anchored alongside Lord Brassey's original *Sunbeam* in one of the land-locked bays in Smith's Channel; she had seen service in the Persian Gulf, the Mediterranean, the West Coast of Africa, and North Atlantic Ocean. Fortunately, in this her last voyage, she had performed the principal work for which she had been chartered, and when she met her fate on the 3rd of this month in Funchal Roads from the torpedo of an enemy submarine, only a few comparatively unimportant tasks still lay before her. But the chief matter for congratulation lay in the fact that the whole of the crew were landed safely, without personal injury to a single one of them. With regard to the *Silvertown*, as there was little chance during the war of their obtaining a contract for the laying of a cable sufficiently long to make a remunerative cargo for her, the directors decided to accept an offer for her as an oil ship. She was built in 1873, and her tanks exceeded in size those of the *Great Eastern*, which was supposed at that time to be specially fitted for cable work on account of her large carrying capacity. The *Silvertown* had laid cables in all parts of the world, from Senegal to Mossamedes on the West Coast of Africa, from New York to Havana, San Francisco to Honolulu, Sydney to Auckland, and Manila to Shanghai. They hoped she would still do useful work during the war as an oil-tank steamer. The question of acquiring another cable-ship with all modern requirements was engaging the attention of the directors. The board had put £50,000 to the reserve fund, which now stood at the same figure as it did immediately before the war. Persan and the foreign branches did very well during the year under review. It must be remembered, however, that the French works were liable to the French war tax, and that this would, of course, reduce the company's available profits. What that tax or the English war taxes would amount to they did not know. The re-issue of their debentures in March last entailed a considerable cash expenditure, together with a liability for additional interest in the future, the present value of which amounted to about £30,000. It was hoped that this large additional financial burden, which was entirely due to the war, would be taken into consideration in making the assessment for the excess profits duty and the munitions levy. Their special activities had made it necessary to limit their output in other directions. This had entailed a loss of trade in the only markets which would be open to us after the war. Considerable difficulties were likely to be experienced in re-occupying this lost ground, and this was a matter which also ought to be held in view by the authorities when imposing war taxation. They felt confident, however, that they would be justly treated by the Government, and they had no apprehensions whatever on the subject. To relieve the congestion of work at Silvertown and to meet the increased demands for war material, the directors had acquired freehold land at Burton-on-Trent, and a shop had already been erected there. The land, about 50 acres in extent, was nearly level, and was flanked by a railway and a canal. It was hoped that after the war they would be able to devote the works at Burton to a great extent to the production of those articles of which, before the war, Germany had obtained a practical monopoly.

Mr. C. H. Gray seconded the motion.

Mr. Drysdale congratulated the directors upon the satisfactory state of the company's affairs, and inquired whether provision had been made for meeting their liability under the war tax. With regard to the new works at Burton, he hoped that the forecast of the chairman as to their being able to capture German trade would turn out to be correct. As far as his experience went, the Germans had always been keen on selling a cheap article, whereas too often the English manufacturer would only sell the article which he thought was best. He knew, for instance, that their Silvertown products were of the very highest quality, but the question was whether they could produce a cheap article which would meet the requirements of the merchant and pay the company equally well. Mr. Drysdale said he took it that the French war tax would be considered as part of the expenses of the French works, and that only the net amount coming to this country would be subjected to our own war tax.

The Chairman, in reply, said the directors had no apprehension as to being able to meet the war tax. They had a large carry-forward of about £40,000, and there was £50,000 placed to the reserve fund, which latter they hoped they would not have to touch. As to the French tax, the double taxation ought not to fall upon them, and he did not believe it would. Justice would seem to point to their not having to pay war taxes to both the French and the English Governments.

Mr. C. H. Gray, replying to Mr. Drysdale, said that in regard to capturing German business, the general policy which the board was going on at present was that they would not attempt to make anything or take anything from the Germans which they could not actually produce and sell at the pre-war prices of the Germans. They had already made sufficient experiments, and they had sufficient knowledge, to assure them that there were many lines which they could actually manufacture at Burton which would fulfil those conditions.

The report was adopted.

Melbourne Electric Supply Co., Ltd.

The annual meeting was held on December 21st, at Finsbury Pavement House, E.C. Mr. J. B. Braithwaite, who presided, said that 122 of the company's employés were now serving with the Forces (23 per cent. of the total staff). Dealing first with the Melbourne undertaking, with regard to the profit and loss account the figures were in every respect satisfactory, and the result reflected the greatest credit on their managing director and staff in Australia. At Melbourne their revenue from private supply had risen from £94,791 to £109,257; that from power had increased from £44,393 to £57,966; the receipts from the tramways supply had grown from £21,443 to £31,389, and the revenue from the bulk supply had risen from £2,529 to £4,860. Thus every item of the revenue showed a considerable increase, the total receipts being £223,153 against £179,752. There had, of course, been an increase in expenditure, the increased cost of coal rendering that inevitable, apart from the very large number of additional units sold. The cost of generation had risen from £35,012 to £47,004; the cost of distribution was slightly reduced; repairs and renewals were £12,396, as against £11,142; and general charges had increased from £19,013 to £24,342. The sum carried to the profit and loss account was £131,673, as against £107,514 in the previous year. It might interest them to know how the increased units sold had been distributed. They had sold practically 24 million units during the year, as compared with 17,486,300 in the previous twelve months, an increase of over 6,000,000 units, which he thought was a very satisfactory increase indeed. It was more significant, however, if they analysed the figures, and saw where the increases had taken place. In private lighting there had been an increase of 18 per cent., and the public lighting had increased by about 17 per cent. Power showed an increase of 40 per cent. The power connections had increased during the year by 2,697 h.p., bringing the total figure up to the very substantial one of between 17,000 and 18,000 h.p., exclusive of the tramway supply. They had sold 6,165,226 units to the tramways, an increase of 39 per cent. over last year. An equally important and satisfactory item in their supply, although it did not bulk very largely at present in their output, was the bulk supply to outlying municipalities. During the year they had agreed to supply two additional districts, which made a total of six local authorities they were now supplying. Their bulk supply had increased 90 per cent., which was proof that the supply was appreciated by municipalities, who greatly appreciated being able to get their power supply from them very cheaply instead of having to put down small power-houses of heir own. Last year he told them that they were doing a small domestic business, such as supplying toasters, shaving water heaters, heaters for curling irons, &c. The sale of units for those purposes during the past year had increased 80 per cent.—a very healthy development. One of the most gratifying features of that increase was that it showed they were pleasing the ladies. They were so pleased with those little domestic uses for electricity that they were not content unless they had their houses lit by the electric light, and it was almost impossible now to let or sell a house in the district of their supply unless it was wired for electricity. With regard to the street lighting, they were now supplying current in nearly 600 miles of streets. Last year he told them they were supplying as far as from London to Aberdeen. During the year they had added another 40 miles and connected 4,500 additional consumers, so they would see that the company continued to make splendid progress, in spite of the drawbacks to which they were subjected owing to the war. Those drawbacks were especially marked with regard to the supply of plant and machinery. They now had to go through all sorts of formalities to get leave to get additional plant. They had to go to the Ministry of Munitions to get certificates, and when the plant was manufactured they had to get special licences to allow it to be shipped for Australia. Fortunately, before the war they had always adopted a policy of keeping their plant just ahead of their demands, and although the 6,000-kw. machine that ought to have been shipped two years ago was

not likely to be out until next May or June, the provision they had made before the war would, he hoped, enable them to carry on, unless, of course, they had a serious breakdown. So far they had managed to pull through without having to cut off anybody from their supply, and he hoped they would continue to do so. There was room for considerable further plant and extensions at their power-house at Melbourne, and they were making provision for putting in additional plant and boilers. A time would come, however, when they would have to consider where they were going to get any additional power they might require, and that matter was engaging the serious consideration of the directors. They were not losing sight of the future, but were endeavouring to make preparations well ahead, so that the company might continue its uninterrupted course of progress and prosperity. With regard to Geelong, that was a shipping port, and the restriction on shipping had naturally affected it. Even there they had made an increase in every item. The profit had risen from £10,162 to £11,641, and the units sold were about 300,000 up. It would be seen on referring to the appropriation account that they were adopting a very conservative attitude.

Mr. R. P. SELLON seconded the motion, and the report was adopted.

Subsequently, extraordinary resolutions were agreed to increasing the capital by £750,000, divided into 50,000 preference shares of £5 each and 500,000 ordinary shares of £1 each, and increasing the borrowing powers of the directors by £250,000.

W. & T. Avery, Ltd.—Dividend of 5 per cent. per annum (6d. per share), less income-tax, on ordinary shares for the half-year.

Chile Telephone Co., Ltd.—Interim dividend, 5 per cent. per annum (3s. per share), free of income-tax, on ordinary shares for half-year.

STOCKS AND SHARES.

WEDNESDAY MORNING.

The Stock Exchange year draws to its conclusion with noticeable confidence in the markets, and, at the same time, noticeable uncertainty with regard to what is going to be done in the way of distributing man-power. The House is naturally discussing a good deal the question as to how far it conducts an essential or non-essential industry, but the answer lies in the hands of the powers that be; and, whatever happens, Stock Exchange men are not likely to raise any particular grumble if they see that they are really wanted for something of more vital urgency to the national interest.

Prices are well maintained. The American Peace Note, which had the effect of producing a violent break in prices in Wall Street, added weight to the growing volume of conviction that Germany's power is broken, and that Austria, especially, will be likely to grasp at any opportunity for bringing the war to a conclusion; although the negotiations to this end may cause the war to drag on for many a long month yet.

There has been comparatively little doing this week, and, in the circumstances, a few comparisons of present prices with those ruling a twelvemonth ago are appropriate. Starting with the electricity supply list, here are some of the principal shares:—

Share.	Price, Dec. 31, 1915.	Present price.	Fall.	Share.	Price, Dec. 31, 1915.	Present price.	Fall.
Brompton ..	7¼	6⅝	⅝	London Elec.	1⅜	1⅜	—
Charing Cross ..	3⅛	3⅛	⅛	Metropolitan	2⅜	2¼	⅛
Chelsea ..	4½	3	1½	St. James'	6½	6	½
City of London ..	12¼	11⅜	⅞	South London	2¼	2⅛	—
County of London	10	10⅛	+⅛	Sth. Met. Pref. ..	1 1/16	1 1/16	+3/16
Kensington ..	6	5⅝	⅜	Westminster ..	6½	5⅝	⅝

Business in electric lighting shares has been very quiet throughout the year, in consequence of the lighting restrictions, the Daylight Saving Bill, and the difficulties as regards coal, labour, and material. Only County ordinary and South Metropolitan preference have managed to secure a rise on balance.

More activity has developed in the telegraph market, where prices have on the whole improved, as the following list shows:—

Share.	Price, Dec. 31, 1915.	Present price.	Rise.	Share.	Price, Dec. 31, 1915.	Present price.	Rise.
Ang.-Am. Prd.	100⅜	95½	— 5⅛	Gt. Northern .	33½	37	3½
ditto Dfrd.	22⅛	23½	⅜	Indo-European	48	49½	1½
E. Extension..	12⅛	14	1⅞	Marconi ..	1⅛	2⅛	1
E. Telegraph..	128	140½	12½	W. Ind. & Pan.	1⅛	1	—
Globe Ord. ..	10⅜	12½	2⅛	Western ..	12⅜	13⅞	1½

Marconis proved a lively market during certain parts of the twelve months, and, after rising above 3, are still £1 higher on the year.

Railway stocks came into pronounced favour during the last few weeks; and a feature has been the steady rise in Underground Electric Incomes for months past, for reasons which have been indicated frequently in these columns from week to week, the bonds having been recommended here, as a speculative investment, from 75 upwards. We set out a few comparisons:—

Share.	Price. Dec. 31, 1915.	Present price.	Rise.
Metropolitan ..	24½	25	½
District..	15⅝	16½	⅞
Underground Ordinary	1⅜	2½	10/-
,, Income	77	92½	15½

In the foreign list, the slump in Mexicans has continued almost without interruption, but British Columbia stocks are irregular on balance. Brazil Tractions have been as high as 65 during the year, and they close, as will be seen, at 49:—

Share.	Price, Dec. 31, 1915.	Present price.	Fall.	Share.	Price, Dec. 31, 1915.	Present price.	Fall.
Braz. Tractions..	51	49	2	Mex. Trams ..	42	24½	17½
B.C. Elec. Pref...	60	60⅜	+2⅜	Mexico Trams	5		
Do. Defd...	40	35½	4½	per cent. Bonds	49	32½	16½
Anglo-Arg. Trams,				Mex. Light Com.	30	7½	22½
1st Pref. ..	4½	3	1½	Ditto 1st Bonds	47	27½	19½

Substantial rises have taken place in many of the shares of the manufacturing companies, as the following list shows:—

Share.	Price, Dec. 31, 1915.	Present price.	Rise.	Share.	Price, Dec. 31, 1915.	Present price.	Rise.
Brit. Aluminium	1⅛	1⅛	⅛	Edison fully-paid	1	1⅛	⅛
Brit. Insulated..	10½	11⅞	1⅜	Elec. Con. ..	14'	1 1/16	7/8
British Westing-				Henley ..	13½	16	2½
house Prof. ..	1 5/8	2⅜	7/16	India-Rubber ..	9½	13½	4½
Callenders ...	10½	13	2½	Tele. Con. ..	34½	38	3½
Castner	3	3 5/16	5/16				

Investment business has not been bad, taking the year through. Having regard to the absence of speculation, on the Treasury prohibition, the volume of Stock Exchange trade has been reasonably active, and the above price lists exhibit clearly how investors have taken stock at rising figures.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Dec. 27, 1916.	Rise or fall this week.	Yield p.c.
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary ..	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref..	4½	4½	3 7/16	—	6 11 0
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11⅜	—	7 0 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 18 3
do. 6 per cent. Pref.	6	6	10	+ ⅛	6 1 6
Kensington Ordinary	9	7	5⅝	—	6 4 5
London Electric	4	3	1½	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/16	—	6 15 4
Metropolitan	3½	3	2¼	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall ..	10	8	6	—	6 13 4
South London	5	5	2⅞	—	7 5 6
South Metropolitan Pref. ..	7	7	1 3/16	—	6 7 3
Westminster Ordinary	9	7	5⅜	— ⅛	6 4 5

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	6	6	95½	—	6 5 8
do. Def.	30/-	33/6	28½	—	7 10 0
Chile Telephone	8	8	7½	—	5 12 8
Cuba Sub. Ord.	6	5	6¼	—	6 8 6
Eastern Extension	7	8	14	—	*5 14 4
Eastern Tel. Ord.	7	8	140½	—	*5 14 0
Globe Tel. and T. Ord.	6	7	12½xd	—	*5 12 0
do. Pref. ..	6	6	10xd	—	5 18 5
Great Northern Tel.	22	22	37	—	5 19 0
Indo-European	13	13	49½	—	6 11 4
Marconi	10	10	2⅛	—	3 19 5
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord. ..	10	10	2 5/8	—	4 6 6
United R. Plate Tel.	8	8	6 1/16	—	*5 19 8
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	18¼xd	—	*5 15 4

HOME RAILS.

Central London, Ord. Assented	4	4	6½	—	6 2 3
Metropolitan	1½	1	25	— ½	4 0 0
do. District	Nil	Nil	16½	—	Nil
Underground Electric Ordinary	Nil	Nil	2⅜	—	Nil
do. do. "A" ..	Nil	Nil	6/6	+6d.	Nil
do. do. Income	6	6	92½	—	*6 9 10

FOREIGN TRAMS, &c.

Adelaide Sup. 6 per cent. Pref.	6	6	4⅛	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3xd	—	9 3 4
do. 2nd Pref. ..	5½	5½	2⅜	—	—
do. 5 Deb. ..	5	5	69½xd	−3	8 0 0
Brazil Tractions	4	4	49	+2½	8 3 4
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	5	6⅜	—	8 0 0
do. do. Preferred —	Nil	Nil	40½	−2	Nil
do. do. Deferred —	Nil	Nil	35½	−5	Nil
do. do. Deb.	4½	4½	82	—	6 17 4
Mexico Trams 5 per cent. Bonds	—	Nil	32½	—	Nil
do. 6 per cent. Bonds	—	Nil	27½	—	Nil
Mexican Light Common ..	Nil	Nil	7½	−5	Nil
do. Pref.	Nil	Nil	15½	−2	Nil
do. 1st Bonds ..	Nil	Nil	27½	−5	—

MANUFACTURING COMPANIES.

Babcock & Wilcox	14	15	21⅜	—	5 6 9
British Aluminium Ord. ..	5	7	30/-	—	5 6 8
British Insulated Ord.	15	17½	11⅜	—	7 6 10
British Westinghouse Pref. ..	7½	7½	2⅜	—	6 6 4
Callenders	15	20	13	—	7 13 10
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	22	5 1/16xd	+ ½	6 3 7
Edison & Swan, £3 paid ..	Nil	—	7/16	—	Nil
do. do. fully paid ..	Nil	—	1⅛	—	Nil
do. do. 4 per cent. Deb.	5	5	62½	—	8 0 0
Electric Construction	6	7½	1 1/16	—	7 1 2
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	13⅜	—	7 5 6
Henley	20	25	16	— ½	7 13 10
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	13½	— ½	*7 8 2
Telegraph Con.	20	20	38	—	*5 5 0

* Dividends paid free of income-tax.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1916.

The November returns of electrical export business show a falling off in value as compared with previous months, the total amounting to £438,830, as compared with £501,822 in October and £573,314 in September. The electrical imports into this country, on the other hand, reached a somewhat higher value, amounting to £198,492 worth, as against £187,261 worth in October.

The re-exports at £18,367 were also higher, being some £7,000 in advance of the previous month's figures.

The decline in export values is apparent in nearly every section of the table, excepting the lamp and miscellaneous sections, the former of which shows a considerable advance on the last month. Electrical machinery exports amounted to, approximately, £150,000 in value, while cable exports reached, roughly, £80,000 in value. In the imports section, the electrical machinery business was on an increased scale, while lamp and cable imports fell off in value considerably.

During the month France was our best customer; India, our Australian Colonies, China, and Japan were also prominent in the list, while of the importers into this country, the U.S.A.—the foremost—did a somewhat greater business than in October, though in other directions not much movement was shown.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	6,253	2,375	116	3,686	5,117	1,191	5,298	2,351	439	978	121	5,768	33,693
Netherlands, Java and Dutch Indies ...	480	10,432	1,297	55	111	20	901	140	216	512	184	2,473	16,821
Belgian Congo...	65	...	...	...	...	...	...	...	...	...	...	...	65
France	3,820	249	774	482	275	73	21,314	4,977	644	25	20,428	3,223	56,284
Portugal	77	244	69	861	389	...	93	...	23	37	304	4,680	6,777
Spain, Canary Isles and Spanish N. Africa...	1,014	52	149	...	...	454	3,784	77	36	...	44	349	5,959
Switzerland, Italy and Austria-Hungary ...	1,749	200	195	...	...	745	9,875	...	10	55	682	3,765	17,276
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	...	...	60	...	...	...	...	116	176
Channel Isles, Gibraltar, Malta and Cyprus...	314	39	55	37	...	19	89	...	...	...	...	12,569	13,122
U.S.A., Philippines and Cuba	1,737	...	170	243	...	...	236	...	...	21	624	253	3,284
Canada and Newfoundland	331	...	379	95	...	994	1,621	4	11	...	183	64	3,682
British West Indies and British Guiana ...	49	...	80	24	...	119	257	...	21	...	12	16	578
Mexico and Central America	18	...	...	...	...	...	...	...	...	...	...	...	18
Peru and Uruguay	...	...	101	42	...	...	...	...	...	...	...	194	337
Chile	378	1,008	402	66	...	623	1,386	...	30	104	16	469	4,482
Brazil	500	622	139	382	...	...	772	1,180	264	1	407	69	4,336
Argentina	881	52	458	357	19	1,944	590	154	1,106	42	1,698	806	8,107
Colombia, Venezuela, Ecuador and Bolivia...	35	67	13	...	...	...	214	...	61	...	...	...	390
Egypt, Tunis and Morocco	240	...	82	414	...	...	211	15	100	19	...	976	2,057
British West Africa	107	6,632	19	222	...	12	2,128	349	29	20	272	459	10,249
Rhodesia, O.R.C. and Transvaal	1,573	4,544	3,608	3,202	235	180	4,072	1,602	523	138	4,225	1,023	24,925
Cape of Good Hope	1,066	4,244	618	1,269	...	60	1,155	1,504	2,137	13	394	922	13,382
Natal	876	9,385	1,202	439	...	156	5,721	1,127	1,303	68	46	765	21,088
Zanzibar, Brit. E. Africa, Mauritius & Aden	297	302	620	770	...	144	1,288	49	123	...	322	107	4,022
Azores, Madeira and Portuguese Africa ...	154	23	18	133	...	34	714	...	33	...	9	143	1,261
French African Colonies and Madagascar...	48	92	217	4	...	...	...	60	...	...	...	...	421
Persia	46	211	6	56	...	23	60	99	80	...	82	110	773
China and Siam	1,676	8,354	794	558	13	1,889	2,973	390	935	72	275	311	18,240
Japan and Korea	316	...	51	79	1,615	1,441	781	8,763	773	20	...	...	13,839
India	4,381	3,670	4,100	4,268	35	910	19,354	3,568	2,964	135	413	983	44,781
Ceylon	4	121	572	50	...	18	270	...	37	...	362	408	1,842
Straits Settlements, Fed. Malay States and Sarawak	328	317	352	274	...	19	444	324	231	42	592	349	3,272
Hong Kong	367	1,043	162	314	174	888	595	74	...	76	18	888	4,599
West Australia	93	923	665	202	...	204	418	...	244	...	3,207	...	5,956
South Australia	107	871	1,001	316	...	188	556	93	24	34	1,821	72	5,083
Victoria	1,631	7,817	3,029	1,764	...	1,163	4,919	152	875	32	2,243	770	24,395
New South Wales	1,545	9,500	3,697	1,405	96	1,441	14,947	3,176	1,733	135	3,013	395	41,083
Queensland	198	347	297	62	...	...	829	...	...	17	2,157	...	3,907
Tasmania	313	1,739	8	125	...	...	39	...	...	...	...	23	2,247
New Zealand and Fiji Islands	911	4,603	1,448	1,652	...	929	2,963	730	723	6	1,669	387	16,021
Total, £	33,978	80,078	26,963	23,908	8,079	15,881	110,927	30,958	15,728	2,602	45,823	13,905	438,830

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	...	...	...	2,540	...	6,102	...	1,506	...	...	10,148
Netherlands	144	...	...	13,531	7,702	...	300	260	1,290	...	...	23,227
France	241	152	12	268	54	880	140	...	7,307	1,312	45	10,411
Switzerland	1,252	...	60	83	...	1,467	438	148	820	821	...	5,089
Italy	...	2,786	...	...	...	...	1,398	415	...	...	...	4,599
Japan	398	...	3,318	7,434	695	...	...	...	413	...	67	12,325
United States	8,923	9,174	1,471	3,283	862	3,729	5,593	50,068	12,704	13,659	20,992	130,458
Total, £	10,958	12,112	4,861	24,599	11,853	6,076	13,971	50,871	24,040	15,792	21,104	196,257

Additional imports.—Spain, carbons, £606. Canada, wires and cables, £30; batteries, £1,296; glow lamps, £140; fittings, £10; electrical machinery, £56; electrical goods, £97.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above ...	2,386	2,518	...	4,267	105	3,363	2,818	...	309	123	2,478	18,367

TOTAL EXPORTS: £438,830 TOTAL RE-EXPORTS: £18,367 TOTAL IMPORTS: £198,492

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned which is not necessarily the country of origin.

CONTROL SYSTEMS FOR TRACTION MOTORS.

A recent convention issue of our American contemporary the *Electric Railway Journal* contained an interesting review of modern developments in electric railway and tramway car construction, more especially dealing with the trend of American practice.

Of particular interest is the summary of developments in control systems, of which the following is an abstract.

Control systems for modern electric railway cars may be classified as direct and indirect, this division being based on the method used in performing the switching. Both use the series-parallel method of adjusting the voltage, wherein the motors, or groups of motors, are arranged first in series and then in parallel, the "non-rheostat" system for four-motor equipments giving an intermediate step with the motors in two series groups.

In order to effect the rearrangement of motors or the change from the series to the parallel connections three schemes are in use, namely, the shunting-out, the bridge, and the open-circuit transition. The shunting-out method short-circuits one motor, or group of motors, while the controller handle is being moved from the last series position to the first parallel position on the controller. The decrease in tractive effort which occurs when this is done tends to produce an unpleasant jerk during acceleration, particularly if the cars are heavy. At present this method is largely confined to control equipments, both direct and indirect, for small and medium size motors. The bridge system is now widely used with in

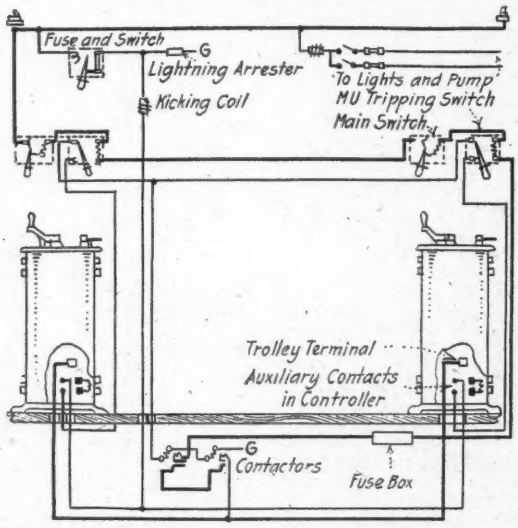

FIG. 1.—CONNECTIONS OF MODIFIED DIRECT CONTROL.

direct control systems for large motors. Direct controllers equipped with the bridge transition have not proved very satisfactory because of the time element involved in making the various circuit connections. The connections in this system are such that all motors are working during the transition period, with the result that a fairly uniform tractive effort is maintained throughout the notching-up portion of the accelerating period. The open-circuit transition at one time was quite widely used in connection with direct control for large motors, but the development of the bridge transition and the indirect systems of control has rendered it practically obsolete for the heavier classes of service. It is still used, however, with some of the modified forms of direct control.

Direct Control Systems.—Of the direct control systems, the most familiar is that in which the Type K controller is used. Within recent years the most important developments in connection with this controller have been its adaptation for use with field-control motors and the many improvements in structural details. For the more recent designs, 600 volts, 750 volts, and 1,300 volts are the standard voltage ratings. Those rated at 1,300 volts were designed for use on interurban roads having a trolley voltage of 1,200, but they have not proved very popular in interurban and all high-voltage services, the tendency being toward the use of indirect control.

Direct control was used five years ago on practically all city and suburban cars, and on many of the lighter interurban and rapid transit cars. However, in the heavier services this type of equipment was rendered objectionable because of the large size of controller necessary. Its use to-day is largely confined to city car equipments where the motors are of less than 50 H.P.

A modification of direct control has recently come into rather wide use; it combines a number of the advantages of both direct and indirect control. In this system remote-controlled circuit-breaking or contactor switches are mounted underneath the car to break the main power circuit. These switches are used in connection with a regular cylindrical controller, and they relieve the controller fingers of the heavy arcing and burning incident to the rupture of circuits carrying heavy currents. The controller is provided with an auxiliary contact device on the main cylinder, which consists of two contact fingers operated by a pivoted arm that in turn is actuated by a cam on the controller drum. The action is such that when the drum is turned in the "on" direction the main circuit drum fingers close first and then the control fingers. The power circuit is thus closed by the contactor switches instead of by the main drum fingers. Provision may be made for a tripping mechanism which, in case of overload, operates the tripping switch and thus permits the contactors to open.

This type of control is not only more reliable than the standard direct control, but the use of remote-control switches in the main power circuit makes possible the interlocking of the control system with door opening and closing and other safety devices. In fact, the latter advantage has been very largely the cause of its popularity.

Indirect control was developed primarily to permit the operation of several cars as a unit from the master controller

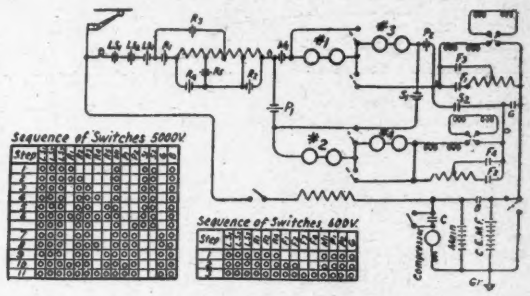

FIG. 2.—CONTROL DIAGRAM, 5,000-VOLT. D.C. EQUIPMENT.

of the leading car, and up to a few years ago its application was largely confined to rapid transit cars, suburban cars on electrified steam lines, and electric locomotives.

Indirect-Control Systems.—Indirect control is now used altogether for rapid transit and other heavy services and quite widely in interurban service. In the latter case it is almost universal where the contact line carries more than 600 volts. In city service it is being used to a limited extent, largely without the multiple unit feature, however, particularly in connection with some of the low-floor types of car, because of the ease with which the various control features may be segregated and mounted in limited spaces and the readiness with which safety features may be incorporated.

By the addition of a current limiting relay, which opens a control circuit when the motor current exceeds a predeter-

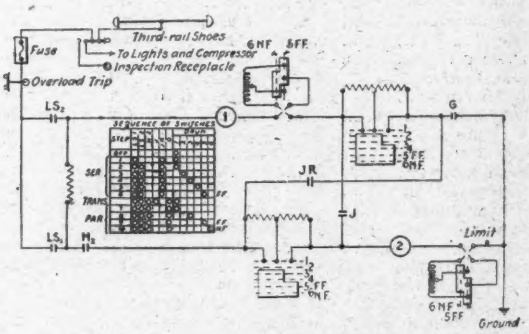

FIG. 3.—DIAGRAM FOR TYPE 214 CONTROL.

mined value, and suitable interlocking devices, either electrical or mechanical, automatic acceleration can be secured with any indirect-control system. Automatic acceleration ensures against abuse of the motors by the motorman, and tends to provide a fairly uniform rate of acceleration. It has long been used on elevated roads and in other rapid transit service, and in connection with some of the new light-weight, indirect-control designs it seems to be gaining in popularity for city service.

The earlier indirect-control systems were too heavy, and besides, automatic acceleration was quite often a feature of these equipments. This was of importance where operating conditions were more or less uniform, but did not have so many advantages when applied to interurban service. There were the objections, also, of high cost and complexity; for these reasons simplified types of hand-operated indirect-control systems were developed, and during the last five years they have found wide application.

Of these systems, the Westinghouse H L and the General Electric M K are the best known. In both these systems the arrangement of control handles is similar to that of the Type K controller, and the energy for the auxiliary control circuit is taken through a resistance from the contact line.

The main parts of these systems are the main or motor controller and a master controller which operates in proper order the switches of the motor controller. These switches are closed against springs by electrically-controlled compressed air cylinders or powerful solenoids.

The unit switches are equipped with arc chutes and magnetic blow-outs. An overload relay is used which either opens the control circuit and trips out all the contactors or a remote-controlled line switch.

The H L system has been further simplified, and is being applied to light-weight cars. The M K system is being superseded to a certain extent by a later P C type of control.

Indirect control systems for use in connection with high-voltage, direct-current motors are essentially the same as those used with lower voltages. Complications are sometimes necessary because the motors are required to operate at low voltage within cities. In the latter case, to ensure the opening of the power circuit, two switches connected in series are generally used to make the interruption.

In connection with the control of alternating motors the only development of special interest is the control for the doubly-fed motor adopted by the Pennsylvania Railroad. This control is an adaptation of the unit-switch system, and it is arranged for automatic acceleration. The motors, which are connected in series, are started and operated up to approximately 15 m.p.h., as repulsion motors, with the auxiliary or compensating field, the armature and the main field in series. With these series connections the armature is also paralleled

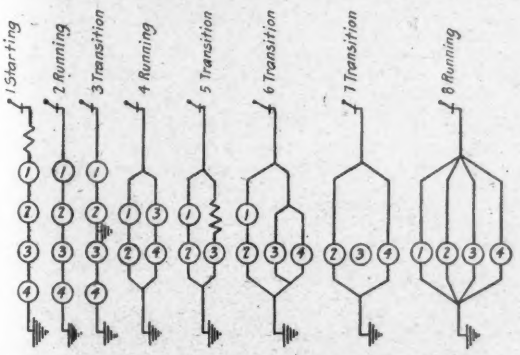

Fig. 4.—Motor Grouping for "Non-rheostatic" Control.

by a resistance. Resistance is inserted with the motors on the first step and is cut out on the second. The third step changes the connections so as to energise the auxiliary field from one portion of the transformer, and the armature and main field, connected in series from another portion, thus affording the doubly-fed connection. The armature short-circuit is removed when the motors are operating with the double feed. Subsequent steps in the control are obtained by increasing the motor voltages.

New Control Systems.—The control system devised originally for the stepless centre-entrance cars of the New York railways, known as the Westinghouse P K control, consists of a drum motor controller equipped with a power-operated notching mechanism. This notching mechanism consists of a pair of opposed air cylinders whose common piston road carries a rack that engages with a pinion on the shaft of the motor-controller drum. Electrically controlled valves admit or discharge air from the cylinders in accordance with the manipulation of a master controller located on the car platform. The motor controller may be located on the platform underneath the car or in some other convenient place.

In appearance the master controller is a miniature platform controller. Manual acceleration is possible, although a current limiting relay is provided on most equipments, and the circuits are so arranged that automatic acceleration will occur in case the controller is moved more than one notch at a time. The latest form of power-operated head can be readily applied to any Type K controller. Energy for the control circuits may be obtained either from the contact line or a storage battery carried on the car.

A later control system brought out under the trade designation of Type 214 control is a combination of the principles involved in the P K and the older A B F system. As designed for the field-control motors of the New York Municipal Railway rapid transit cars, the motor controller box includes the following parts: Two unit switches acting as circuit breakers, four unit switches for series paralleling the motors, one drum-type reverser, one drum-type commutating switch, one current-limit relay, one overload relay, one main circuit terminal board, and one control circuit terminal board. Electro-pneumatically operated unit switches, interlocked to secure proper sequence, are used for making main-circuit changes while a commutating switch of the drum type, operated by a P K notching mechanism, is used to cut out resistance. A line relay cut-out permits feeding up of the control when power is off the line and the bucking of the motors for emergency braking in case of failure of the air brakes.

The automatic acceleration feature of this control is particularly interesting as the action of the current-limiting relay is modified by the current passing through an auxiliary winding of the relay, in such a way as to provide for the same rate of acceleration for all loads. The amount of current passing through this auxiliary winding is controlled by a switch operated in connection with the variable-load brake mechanism. The adjustment of this mechanism corresponds directly to the deflection of the bolster springs under load. Energy for the control circuit is obtained from a 34-volt storage battery, which also furnishes energy for emergency car light, signal lights, door interlocks, and other special circuits. This control is designed for use with the larger motors, those on the New York municipal cars being rated at 160 h.p. on 600 volts.

In the P C control equipment, recently placed on the market by the General Electric Co., the motor controller consists of a group of switches or contactor units (used for effecting the series and parallel groupings of the motors and in cutting out resistance, together with a reverser, a circuit-breaker and overload, potential and current-limiting relays, all of these being assembled in a single case. The contactors are closed mechanically by means of cams mounted on a shaft which is revolved by a rack and pinion. The rack is operated by two air cylinders, whose valves are electrically controlled by the master controller. All of the contactor arc-chutes are grouped in one unit similar in construction to that used in the ordinary drum controller. The circuit-breaker switches are also operated pneumatically and controlled electrically. The overload relay operates to de-energise the control circuit of these switches in case of excess current. When opened by an overload, a reset switch must be thrown to close them again. The switches are of the unit type, and are readily removed. The reverser is very similar to the drum reverser used in a Type K controller, except that it is power operated by means of compressed air cylinders with electrically-controlled valves.

The master controller is similar in general construction to that used with the Type M control systems built by the same company. It is provided with a slip-ring attachment which closes the control power circuit when the handle is moved from the "off" to the first position, and maintains the circuit for any forward motion, but opens it if the handle is moved back.

This type of control may be arranged either for automatic or hand acceleration, and may receive the power for the control circuit either from the contact line or storage batteries carried on the car. As with most modern systems of indirect control, the power circuit is opened in case the motorman removes his hand from the control handle, and provision may be made also for setting the brakes.

Non-rheostatic Control.—From the standpoint of economy and flexibility in speed regulation, the non-rheostatic control for the four-motor cars of the Pittsburgh railways is of interest. In this system resistance is used on only two transition points, the first and fifth, and as there are three running notches the transition points are used only for very short intervals, so that there are practically no rheostatic losses.

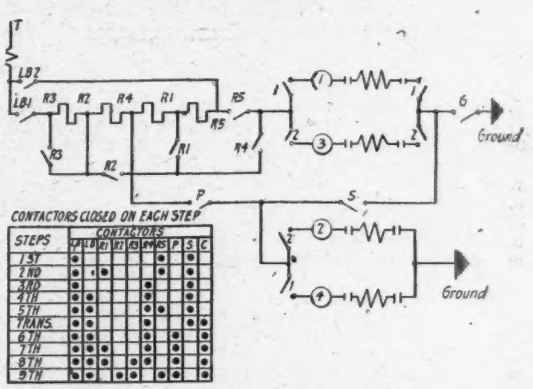

Fig. 5.—Contactor Sequence for P.C. Control.

Frequent use is made of the first running notch with all motors in series, and as low speed can be secured on this first point, excessive controller operation is avoided, and savings in the maintenance costs of control equipment, wheels, and brakes are effected. Tests over an extended interval of time indicate that the energy consumption is from 8 per cent. to 15 per cent. less than with a standard series-parallel control when used on cars of the same weight operating in a similar service.

The contactor switches are arranged in two switch group cases under the low floor of the car. The combinations and connections provide for interlocks on the contactors to establish holding circuits whereby the motors are maintained in parallel groups while the control handle is being thrown to the "off" position, thus affording a closed path of low resistance for the discharge of the energy stored in the magnetic fields of the motors. The use of field control with this system would, of course, add some complication, but would result in a speed flexibility practically equal to that of the steam locomotive.

Wiring.—Electrically-controlled brakes, speed-control devices, car signal and door interlocking circuits result in the new cars of the New York Municipal Railway in the use of 18 train wires, of which only seven are used directly for control purposes, and the wires are of extra large cross-section so as to permit the multiple-unit operation of a large number of cars.

With indirect systems, a knife-blade switch of the quick-break variety connected between the trolley base and main fuse, is used to disconnect the main circuit so that the motor controller can be operated for test or inspection purposes. The use of a main fuse box of the magnetic blow-out type is becoming almost universal, the accepted form of fuse consisting of a thin copper ribbon held at the ends between heavy clamps.

Later practice in car wiring tends toward the use of light steel conduit that is enamelled, galvanised, sherardised, or treated in some other way to make it rust-resisting, the conduit for some of the later cars having walls only 1/32 in. thick. In cars designed for very light weight there is an increasing tendency to use some of the fireproof non-metallic conduits now on the market. Of these one that has been extensively used is made of natural warp cotton yarns woven

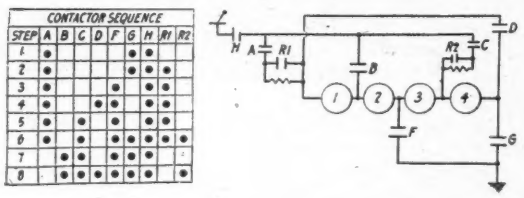

FIG. 6.—SWITCH SEQUENCE FOR "NON-RHEOSTATIC" CONTROL.

very tightly to give it strength, and saturated with a waterproof and fireproof compound. It is more economical than metallic conduit, not only because the price is much less, but also because no fittings are required, since the non-metallic conduit can be bent into any desired position. The weight of ¾ in. conduit in this material approximates 0.13 lb. per ft., while metal even 1/32 in. thick should weigh 0.25 lb., including the fittings.

The arrangement of control details in a few groups has greatly simplified the control wiring necessary, and there is a tendency to use multi-conductor cables for the motor and other current-carrying leads instead of single wires.

With regard to lightning arresters, the magnetic blow-out types are still very popular for car service, and a form of condenser arrester seems to be meeting with some favour.

The aluminium-cell type of lightning arrester has not met, as yet, with great favour among operating men; several companies have installed it on their latest types of cars. There is a tendency to use larger choke coils than were used formerly. The favoured location of the arrester seems generally to be on the roof of the car.

Control Circuit and Door Interlocking.—In an effort to promote safety and accelerate traffic, several methods of interlocking the car doors and the control system have been devised. Generally speaking, any of these schemes is applicable, as far as principle is concerned, to any system of indirect control as well as to the system of modified direct control. The door apparatus consists of a wooden rod attached to the door and upon which is a brass ferrule. When the door is closed this ferrule engages with a pair of contactors which form a part of the circuit energising the contactor, or line switch in the motor control. In any position of the door, except tightly closed, these contactors engage with the wooden surface of the rod and not with the brass ferrule. Consequently, the contactor control circuit is open and the contactor itself cannot be closed, but when the door is shut the control circuit is complete, and the motors are under the control of the motorman. This enables a motorman to set his controller handle on the starting position immediately after a door is opened at a stop. Then, when the door closes, the car starts ahead at once without any signal from the conductor. Frequently switches are provided that operate in connection with the conductors' emergency brake valve. The operation of this valve, therefore, shuts off the power as well as sets the brakes, and eliminates the current surge that would result if the motors pulled against the brakes until the overload relay tripped.

Such interlocking devices, by permitting a quick start after passengers are loaded, have a very marked effect in speeding up traffic. They eliminate to a large extent the need of a signal system for the conductor, and by requiring the door to be shut before the car can be started, reduce the number of door and step accidents.

Australian Commonwealth Offices.—On December 27th the offices of the High Commissioner for the Commonwealth of Australia were removed from Victoria Street to Australia House, Strand, London, W C

REVIEWS.

Large Electric Power Stations. By Dr. G. KLINGENBERG. English translation from the German. London: Crosby Lockwood. Price 25s. net.

The publisher's note to this book states that the translation supplied by the author was in type some months prior to the war, and that the proofs have been subjected to careful revision by an English engineer, and in view of the importance of the subject it has been decided not to delay publication further.

The increase in the public importance of electricity supply is bringing about a change in opinion as to the basis on which electricity should be produced and distributed.

The fundamental question is whether the generating station should be a private one, one controlled by a municipal body, or one managed by a company. Nowadays, unless in a very isolated area, a private power station would prove uneconomical. It also seems impossible for a municipality to manage its electricity supply undertaking on any but what may be called political lines. The engineer-in-charge will be asked for his opinions on engineering or economic problems, but the electricity committee's decisions are necessarily governed by the policy of the party to which the majority of its members happen to belong. On the other hand, the management of a supply company presents an entirely different picture. The policy of the company will be controlled by experts in engineering, in business, and in finance. They possess entire control, their decisions are influenced by the interests of the concern only, they can organise and renew their staff according to the ability of the individual, and are necessarily in close touch with industrial and engineering developments. Under municipal control there is not the same incentive to attain the highest possible economy as with a dividend-paying company. These are facts that no one can seriously dispute, and the public is confronted with the question whether it is preferable to allow limited liability companies to take control of the electricity supply business—of course, under proper Parliamentary supervision—or to allow existing municipal supplies to develop or co-operate with private concerns. The future only can say what will happen in this country. The author's views on these and on like matters are set forth in a lengthy and very readable introductory chapter.

Chapter I is one of 78 pages. It deals broadly with the general principles involved in the design of large electric power stations. The use of the various governing factors, *e.g.*, the diversity factor, is first illustrated with the aid of diagrams from various German power stations. This section of the chapter is decidedly clear and valuable. The engine room is then discussed. A quantity of information is given, but the question as to choice of different types of turbines is not entered into at all. The treatment of the selection of generators and auxiliary machinery is fairly good. Some genuinely valuable advice is next given on the design of boiler houses and their contents, together with some data that the reviewer has not seen published before. One of the author's figures appears a little heroic—a steam velocity in the pipes feeding the turbines of 262 ft. per sec. The reviewer would be inclined to think that there would be an appreciable drop in pressure unless the pipes were very short, and further, he would expect some vibration in the pipes on sudden changes in the load. Storage and transport of coal, ash removal, and switchgear are then discussed in a satisfactory, though somewhat brief, manner. For example, five lines only are devoted to protection against lightning in the switchgear section. The chapter concludes with some very sensible advice on the choice of the position of a power station, and on its architecture. As the author rightly says, many power stations resemble theatres more than anything else, and the beauty of a power station building—as of machinery—should be in the simplicity of the design and in its proper proportions. The fact must not be lost sight of that a power station is merely a factory for producing electricity. At the same time, of course, it should be adapted to the appearance of the locality as far as is practicable.

Chapters II and III deal respectively with comparisons of costs of electrical transmission of energy and of the transport of coal, and with economy and generating costs in relation to capacity and utility factor. The value or otherwise of this sort of thing depends, of course, entirely on the initial assumptions made. Some of the costs appear to be distinctly on the low side to the reviewer, but the author's methods appear to be sound, and will serve as a model for similar calculations with different initial costs.

The first constructional example of the principles set forth in the preceding part of the book is that of the Markische electricity works in Germany. The installation is most thoroughly described, and illustrated with plates and photographs. The leading dimensions of essential parts of the plant are given, and also the name of the maker—of course, in every case a German firm. An analysis of the working results is given at the end of the chapter. These are not at all remarkable, but it is to be remembered that the station is five or six years old.

The second and last example is that of the Victoria Falls and Transvaal Power Co., Ltd., in South Africa. The initiation of this enormous power supply scheme and the different

power stations involved is most thoroughly described, and also the possibilities of future extensions. The author states, and probably correctly, that the A.E.G., Berlin, undertook the engineering of the scheme and the installation of the entire plant.

The book consists of 260 pages and a large number of plates. It bears distinct evidence of most careful thought. The translator has also done his work very satisfactorily, the large majority of the units, both money and dimensions, being given in English measure. The work will undoubtedly be of distinct use to engineers engaged in power station design. However, in spite of its merits, 25s. net is a large sum of money to pay for the book. Possibly the large number of plates is partly responsible for the price.—H. G. S.

The Mechanical Handling and Storing of Material. By GEORGE FREDERICK ZIMMER. London: Crosby Lockwood and Son. Price £2 2s. net.

Probably one of the most neglected branches of engineering is that relating to the mechanical handling and storing of material, and we believe "The Mechanical Handling of Material" first published by the author was the first work of any real importance on this subject. The present treatise is a new edition of this work, in which the mechanical handling of material has been brought up to date, and to which the various methods of storing material has been added. The author had an immense field before him, and we must give him credit for making the most of his opportunities; though the work consists mainly of data and particulars of plant gathered from all corners of the globe, it is not the less valuable on this account. In fact, it is not too much to say that the engineering profession should be very greatly indebted to Mr. Zimmer for placing before it a work involving considerable labour in collecting and arranging information dealing with so important a subject as the economy of labour by applying mechanical means to the handling of material in works and factories appertaining to practically every industry.

In an excellent introductory article, the reader is told the necessity for the introduction of labour-saving machinery, and the benefit derived not only by the capitalist, but by the labourer himself is pointed out; as this question may possibly become an acute one after the war, it is necessary that Labour should be educated to recognise this fact, and we can fully endorse the author's statement that "In round figures, it may be taken that the saving of one man's wages warrants the investment of £1,000 in machinery." As an example, the author cites a modern flour mill in which the wheat may be unloaded from an ocean-going steamer, stored, cleaned, graded, ground, dressed, packed, weighed, registered, and loaded into a railway truck for dispatch to the consumer without any manual labour whatever. The view, however, of the Labour leader is that were it not for this machinery men would be employed and wages paid, but he forgets that whilst, no doubt, 20 or 30 workmen are released for other labour, hundreds of their fellow workmen are benefiting by the lower cost of flour. Are the greater number willing to suffer, to benefit—which is doubtful—the few? Moreover, as the author truly points out, the multiplication of labour-saving appliances is not in the least detrimental to the interests of Labour, but, on the contrary, "experience has shown that his daily life is thereby made easier, his intelligence improved, and his wage-earning capacity increased," and in no industry has this been proved to such an extent as in that of mining.

The work consists practically of six parts, viz.: The continuous handling of material; continuous handling of material by pneumatic and hydraulic means; intermittent handling of material; unloading and loading appliances; miscellaneous installations; and the automatic weighing of material.

The first part claims 18 chapters, and deals with elevators and conveyors for every imaginable purpose; naturally, among so many designs there is room for very considerable improvement in some, but to examine critically each design would take several volumes as large as the present to deal with them. There is, however, plenty to choose from as a basis for the design of any particular piece of handling or conveying machinery. It would seem as though in many cases the designer or builder of conveying machinery did not consider it necessary to study the effect of friction as a power consumer, or thought that the economy effected by the use of the conveyor was such that there was a big margin for inefficiency—anything would do for a conveyor so long as it worked. Some that we know of didn't work; not that the idea of the conveyor was bad, but sufficient study had not been given to its construction by the designers to suit the particular conditions. It is mainly so with all conveyors; a little thought and study would greatly improve their efficiency.

The next three chapters deal with the handling of material such as grain, coal, and ashes by pneumatic or hydraulic means. Amongst the latter is mentioned the hydraulic plant at the Hammersmith Borough Council's electric light installation, which was estimated to cost £15,600 and to save £1,577 per annum, or practically 10 per cent. on the capital outlay. As a means of removing ashes from boiler houses the hydraulic system would appear to have many advantages. Some of the pneumatic systems described for conveying grain are both interesting and ingenious, and naturally much more care and workmanship has to be expended on this type of plant.

The intermittent handling of material includes endless-rope and chain haulage, not, of course, as installed in mines, but as applied to moving tubs or small wagons for short distances. It includes all kinds of aerial ropeways, methods of coaling vessels at sea, rails and telphers, and the handling of material in connection with blast furnaces, and coke from coke ovens; some of these are good, but many are indifferent, and others might have been left out altogether. Especially does this apply to some of the German methods for dealing with hot coke from coke ovens.

The last two portions deal with such subjects as the coaling of railway engines, boiler-house handling plants, storage of coal, grain, and other materials, and the automatic weighing of material, and conclude with a table giving the weights of materials.

As we have said, the subject is a huge one, and we are afraid one that has not been sufficiently studied in this country, partly because of prejudice, but mainly, we think, because of our—we hope now obsolete—conservatism. With the ever-increasing cost of labour in production, it becomes more than ever necessary to reduce the producing cost of the finished article, and to release the labourer, otherwise engaged in the handling of material, for more useful employment, where his services will be more productive, both for himself, his employer, and the public generally.

If Mr. Zimmer's book, by showing what has already been done in this direction, and by giving details of examples of conveying and other labour-saving machinery, will help the development of this branch of engineering in this country it will have served a useful purpose.

If we have any fault to find, it is in the bulkiness of the volume, which we think would have been handier had it been published in, say, two volumes instead of one. Otherwise, it is well printed and bound, the illustrations are good, many being folding plates, and the work does credit to author and publisher.

Dynamo and Motor Attendants and their Machines. By FRANK BROADBENT, M.I.E.E. London: S. Rentell & Co., Ltd. Price 2s. 6d. net.

This is the eighth edition of a work which has long held a high reputation, and has established its position as one of those books for which there is always a demand. The text has been extensively revised, over 50 pages have been added, and 40 drawings, a new chapter on accumulators has been inserted, and generally the matter has been brought up to date. The chapter on "General Principles" has also been entirely rewritten. There are a good many misprints, but these are generally obvious, and the author reasonably claims indulgence in view of the revision having been done in strenuous times. The remarkable scope of the book, the conciseness and lucidity of the treatment, and the essentially practical nature of the contents, render it the most useful guide for the class of readers addressed that we know of, and its continued popularity indicates that they concur with us in regarding it as excellent value for the small price at which it is published.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

CHILE.—For convenience of reference, the following particulars of the rates of import duty, now payable on the undermentioned goods on importation into Chile, are taken from the recently-published Parliamentary Return, giving a translation of the new Customs Tariff Law—see the REVIEW of November 3rd:—

		Pesos.	Cts.
India-rubber:—			
Resilient: Raw	kilog. gross	0	04
In sheets	kilog. gross	0	20
With cloth or metal for packing machinery, &c.	kilog. gross	0	36
Vulcanised, in sheets	kilog. gross	1	20
Rubber waste	kilog. gross	0	12
Rubber solution	kilog. legal	0	60
Manufactured articles of rubber, not specially mentioned	kilog. legal	2	50
Boots and shoes, &c., of rubber, or with rubber soles	kilog. net	2	00
Buttons (pushes) for electric bells	kilog. legal	1	80
Iron and steel:—			
Wire in all shapes (including barbed)	100 kilogs. gross	0	50
Lamps for electric lighting	kilog. legal	0	70
Cable or rope of wire	kilog. gross	0	04
Meters for electric current, and parts	kilog. gross	0	20
Copper and its alloys:—			
Sheets, bars, or ingots		Free.	
Bars or cylindrical rods for cutting into bolts	kilog. gross	0	10
Pure, for assaying	kilog. net	1	80
Filings (borings); solder		Free.	
Pipes or tubes not specially mentioned, and accessories	kilog. gross	0	20

		Pesos.	Cts.
Zinc and its alloys:—			
Bars, sheets, or plates		Free.	
Granulated, filings or borings ...	kilog. gross	0	36
Sheets varnished or with coating of common metal	kilog. gross	0	40
Aluminium alloys; aluminium in sheets, plates, strips, or bars		Free.	
Tin or lead:—			
Bars or sheets		Free.	
Granulated, filings or borings ...	kilog. gross	0	25
Pipes or tubes and accessories ...	kilog. gross	0	06
Nickel and white metal:—			
Bars, sheets or plates	kilog. gross	0	25
Manufactured articles not specially mentioned, not silvered or gilt ...	kilog. legal	3	00
Wire, other than iron or steel, of all shapes	kilog. gross	0	01
Babitt's metal and the like	kilog. gross	0	15
Asbestos:—			
In the rough, in powder, or in cords	kilog. gross	0	02
In boards or sheets	kilog. gross	0	10
Manufactured—gloves, &c.	kilog. legal	2	00
Mica:—			
In sheets	kilog. gross	0	60
Manufactured articles	kilog. gross	0	75
Graphite	100 kilogs. gross	1	50
Talc:—			
For industrial uses	kilog. gross	0	05
In very thin sheets	kilog. legal	1	80
Commercial advertising matter, not specially mentioned, of cardboard or paper, except catalogues and periodicals	kilog. gross	1	00
Commercial catalogues and periodicals, &c.		Free.	
Telegraph and telephone instruments and apparatus, &c., not specified ...	kilog. gross	0	05
Special machines, apparatus and appliances for use in generating gas and electric light, not specified; insulators, commutators, contacts, interrupters, extinguishers, cut-outs, fuses, &c., required for electric light installations; arc and incandescent lamps or bulbs, and carbons	kilog. gross	0	04
Machines and apparatus for use in industry not elsewhere specified ...	kilog. gross	0	03
Electric piles or batteries, and jars for same	kilog. gross	0	10
Wire of common metal, of any sectional form, insulated or covered with rubber, silk, &c.	kilog. gross	0	10
Plans and specifications for engineering, architectural, and other works ...		Free.	
Packing cases	kilog. gross	0	06

[*Gross* weight is the weight of the goods with all receptacles and packings, both internal and external. *Legal* weight is the weight of the goods, together with all receptacles (including fastenings) with which they are packed inside the external wrapping, excluding straw, sawdust, &c., used for disposing the parcels. *Net* weight is the weight of goods deprived of all coverings. 100 centavos = 1 peso = 1s. 6d.]

Merchandise or products imported into the Magellan Territory are, with certain specified exceptions, free of duty.

Foreign goods imported into Chile are subject to a warehousing fee. Goods intended for consumption in the country and subject to import duty must pay 4 per cent. of the amount of such duty when cleared during the first four months of storage; 8 per cent. when cleared during the second period of four months; and 12 per cent. when cleared during the third period of four months. In the case of goods free of import duty, the warehouse fee will be 10 centavos per 100 kilogs. gross weight when the goods are cleared within the first four months of storage; 20 centavos during the second period; and 30 centavos during the third period.

The duties payable under the new Tariff Law are to be regarded as the minimum rates, applicable to countries which grant m.f.n. treatment to imports from Chile. The President is empowered to impose a surtax of 25 per cent. of the duties fixed by the Tariff, as a maximum tariff, applicable to products from other countries.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

17,786. "Electric telephones." L. G. Hammer. December 11th.

17,798. "Secondary electric batteries." T. A. D. Lawton. December 11th.

17,803. "Telephone memo-fi.ing receptacle." S. M. Brydges. December 11th.

17,814. "Auto-luminous switch indicator." W. C. Horne. December 11th

17,820. "Electromagnet for lifting materials." Soc. Centrale d'Enterprises A. D. Riviere et Cie. December 11th.

17,834. "Mercury-vapour and other incandescent vapour lamps." F. Bousson. December 12th.

17,851. "Device applicable to electrical machines such as motors, generators, transformers, &c., replacing commutator or collector." G. Pestarini. December 12th.

17,852. "Trolley heads or collectors for electric tramcars, &c." R. Baty. December 12th.

17,856. "Control of electric motors." J. M. L. Slater. December 12th.

17,867. "Manufacture of electric insulating materials." W. E. Windsor-Richards. December 12th.

17,875. "Electric lamp shade." S. C. Morris. December 13th.

17,878. "Sparking plugs for motors, &c." J. W. Law. December 13th.

17,885. "Sparking plugs or electric ignition devices for internal-combustion engines." W. A. Clark, H. G. Longford, W. W. Longford & Sphinx Manufacturing Co. December 13th.

17,916. "Producing alternating electric currents." British Thomson-Houston Co. (General Electric Co., U.S.A.). December 13th.

17,923. "Electric pocket lamps." O. Pletscher. December 13th. (Switzerland, November 18th.)

17,929. "Electrical apparatus having windings." British Electric Transformer Co. & J. Goodman. December 13th.

17,930. "Protective means for electrical apparatus having windings." British Electric Transformer Co. & J. Goodman. December 13th.

17,934. "Arrangements for advancing ignition in internal-combustion engines." Soc. Anon. pour l'Eclairage Electrique des Vehicules. December 13th. (France, December 20th, 1915.)

17,936. "Energy meters for alternating currents." Fabrique des Longines Francillon & Co. Soc. Anon. December 13th. (Switzerland, April 22nd.)

17,937. "High-frequency alternators." Soc. Francaise Radio-Electrique. December 13th. (France, September 16th, 1915.)

17,950. "Galvanic batteries." E. A. Ashcroft. December 14th.

17,972. "Anodes for electrolysis of sulphate solutions, and production of same." A. Colley, W. Hutchinson & A. Hickman, Ltd. December 14th.

17,981. "Method of controlling, and apparatus for producing, ionic discharges." D. F. Comstock & Technicolor Motion Picture Corporation. December 14th.

17,983. "Methods of producing high vacuum." British Thomson-Houston Co. (General Electric Co., U.S.A.). December 14th.

17,987. "Ignition dynamos." C. T. Mason. December 14th. (U.S.A., January 7th.)

17,988. "Ignition systems." J. G. Zimmerman. December 14th. (U.S.A., May 12th.)

17,993. "Collection of currents from overhead, &c., conductors." C. C. Henkes. December 14th.

17,996. "Selection of electric currents." A. Perego. December 14th.

17,998. "Batteries." J. M. Flannery. December 14th.

17,999. "Batteries." J. M. Flannery. December 14th.

18,019. "Cleansing floors of tramcars, &c." N. Jamieson. December 15th.

18,027. "Portable periscopic electric lamp for signalling." E. V. Evans. December 15th.

18,046. "Automatic telephone systems." Automatic Telephone Manufacturing Co. December 15th. (U.S.A., February 14th.)

18,049. "Electric switches." J. H. Collings & M. J. Railing. December 15th.

18,095. "Systems of motor control." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). December 16th.

PUBLISHED SPECIFICATIONS.

1915.

16,615. Burglar or Fire Alarm and like apparatus. A. A. Canton. November 24th.

16,643. Electrolytic Cells. H. C. Jenkins & C.I. (1914) Syndicate, Ltd. November 25th.

16,765. Electromagnetically-actuated Contact Makers or Switches. G. D. Peters & Co., F. C. Hibberd & W. King. November 27th.

16,865. Portable Electric Lamps. V. C. H. Gibson & E. G. Benns. November 30th.

17,125. Carbon Saver for Arc Lamps. D. E. Turner. December 6th. (May 9th, 1916.)

17,276. Cooling of Electric Motors of the Enclosed Type. G. Schroeder. December 8th.

1916.

2,968. Galvanic Batteries. G. Fuller, L. Fuller & G. J. A. Fuller. June 12th. (Patent No. 102,335.)

5,932. Automatic Photographic Printing Machine. Neff & Lumley. April 24th, 1915. (Patent No. 100,363.)

6,036. Electric Welding Apparatus. E. Woltmann. May 1st. (Patent No. 100,401.)

Further German Substitutes.—In the normal rules of the V.D.E., it is recommended that hemp be used in fixing insulators to their pins; but hemp is now reserved for Army use, hence a Committee of the Electrotechnical Union has been investigating possible substitutes, and now advises the use of impregnated paper. Suitable paper impregnated with oil or similar insulating material has been placed on the market by various German firms. A number of sheets, determined by trial, are wrapped round the pin and the insulator is screwed on slowly, using moderate pressure. It is possible by this means to fill the space between pin and insulator, and thus provide a secure but elastic support for the latter. A little practice is required to prevent the paper from tearing or creasing, and to keep the insulator vertical and central. Sackcloth is recommended as another effective substitute for hemp. The Imperial Telegraph Administration uses scraps of wool, sheets of paper soaked in carbolineum, and newspaper (not impregnated). It is remarked that not all the commercial substitutes offered in place of linseed oil may be used for impregnating purposes, because there are sometimes dangerous fumes and, apart from the thread of the insulator, the workmen's eyes might be injured.

The use of oiled paper for this purpose was described in the Electrical Review of March 22nd, 1907, page 503.

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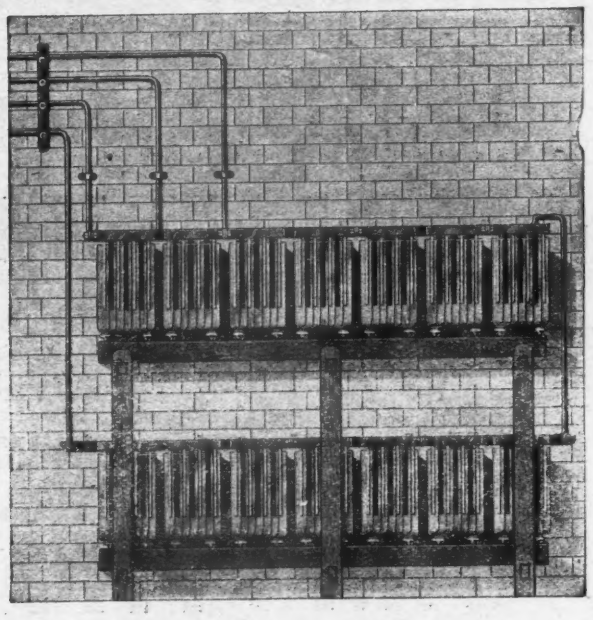

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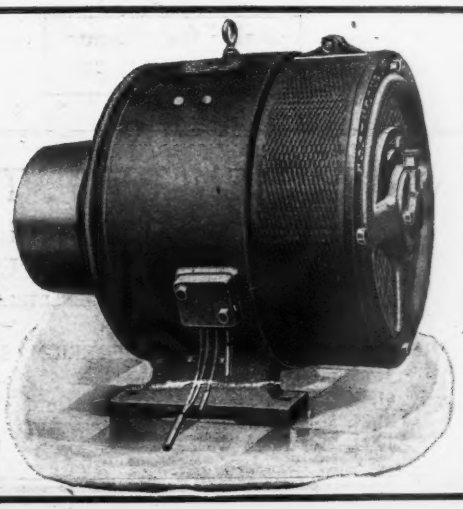

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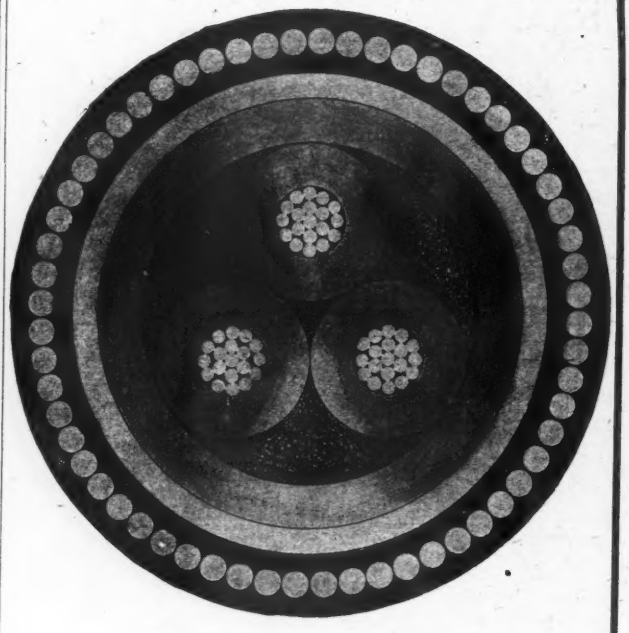

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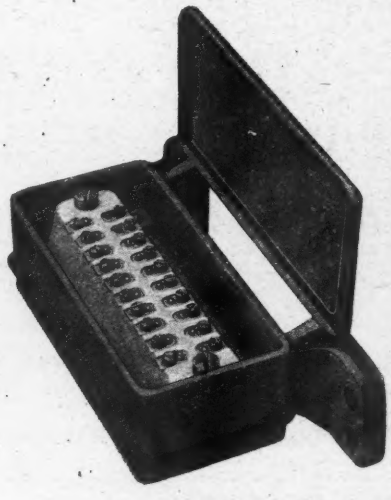

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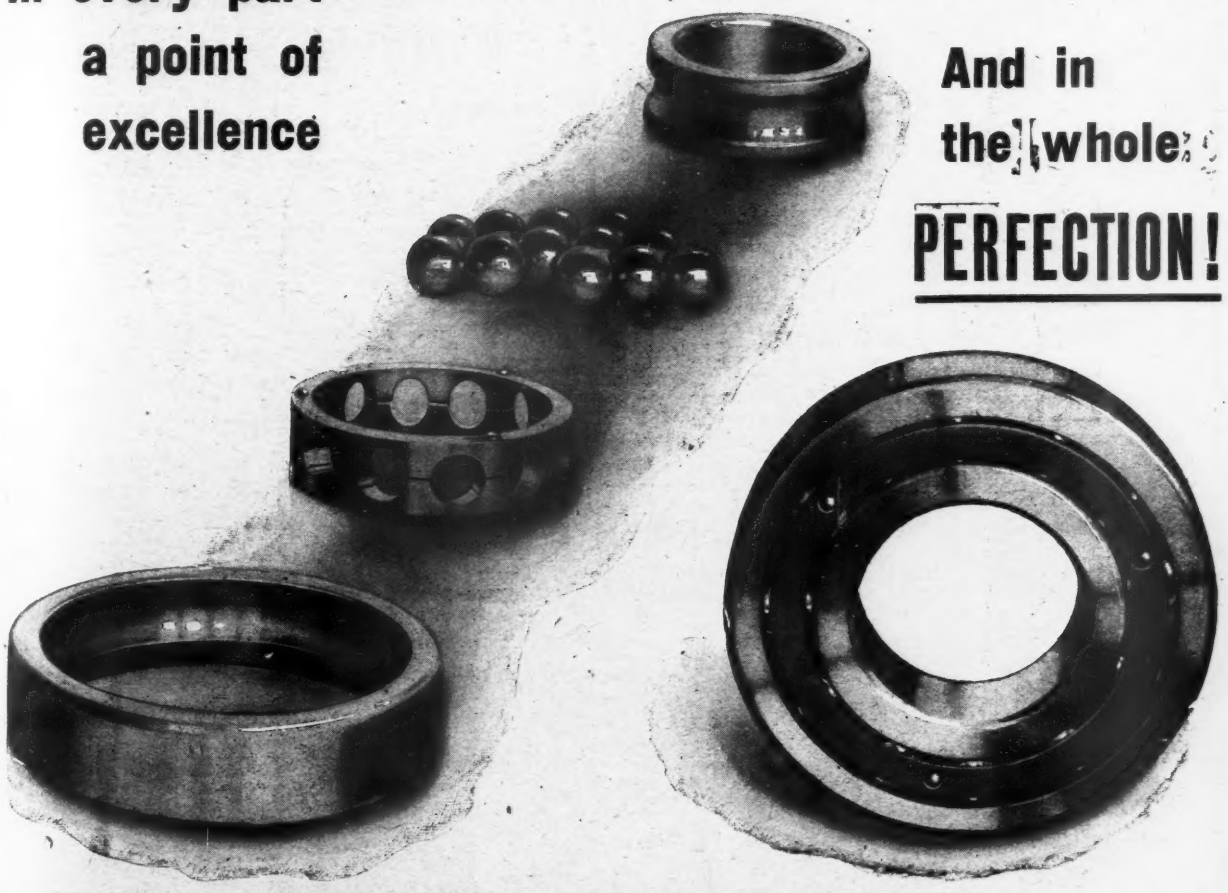

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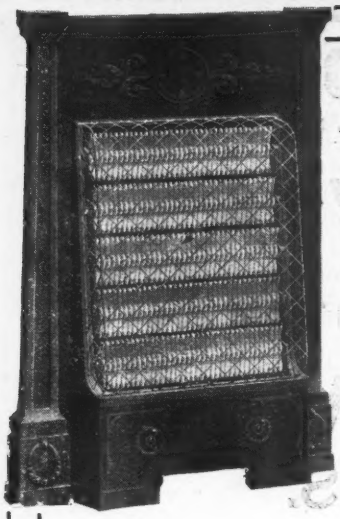

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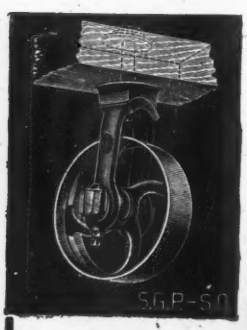

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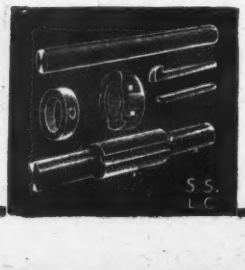

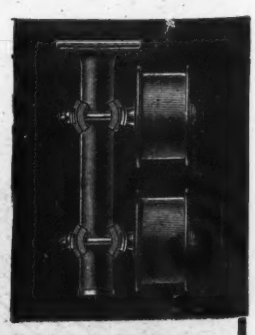

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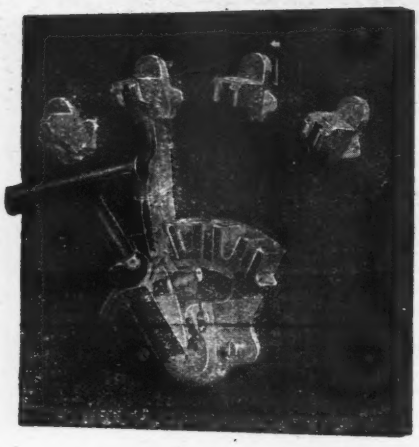

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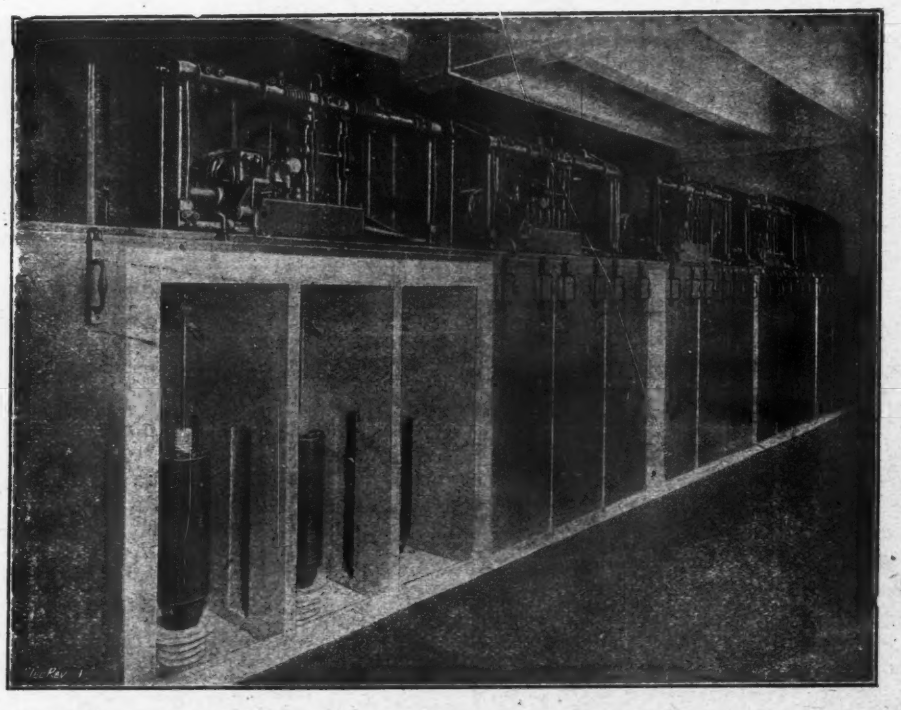

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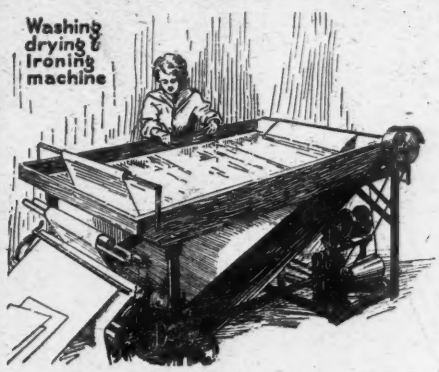

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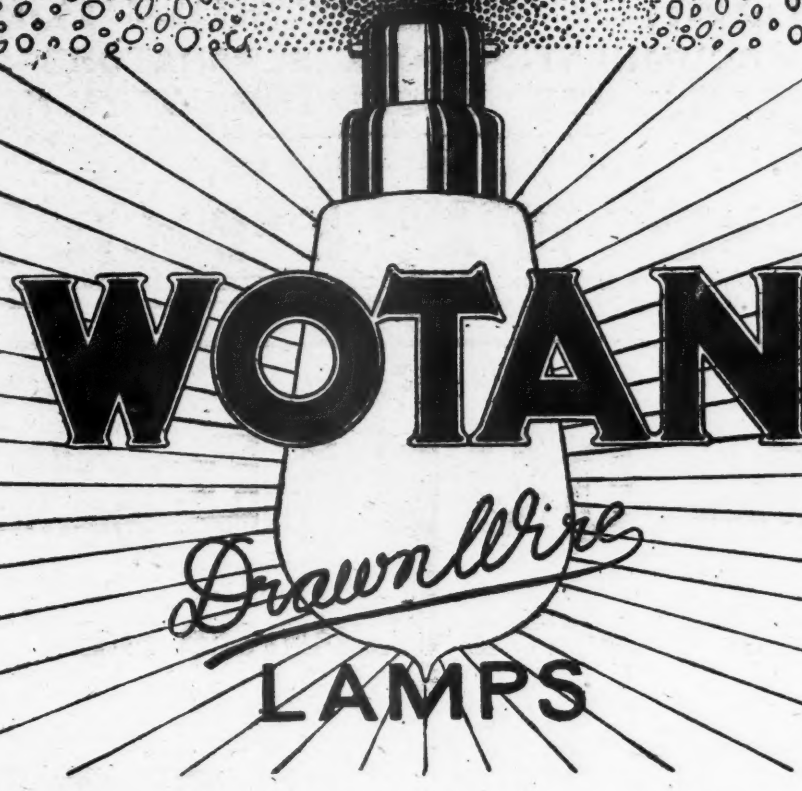

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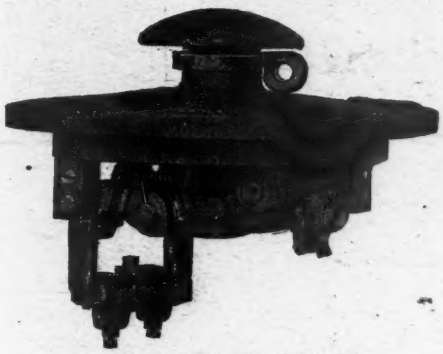
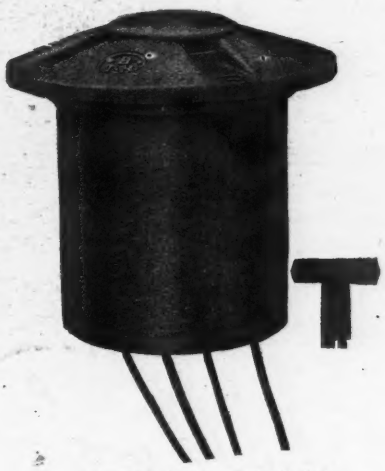


Interior of Capstan Pedal Switch for unexposed positions, with locking collar to prevent tampering.



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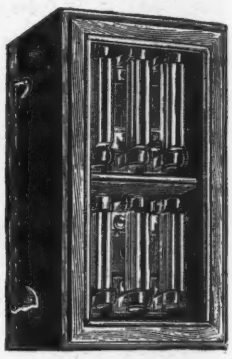

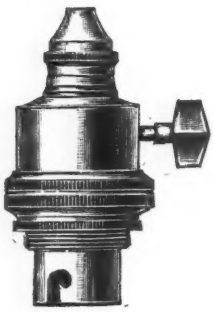

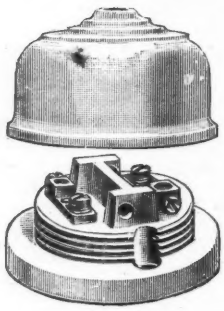

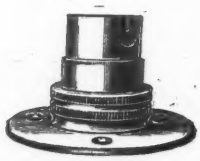

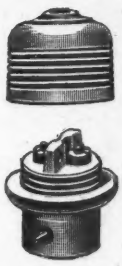

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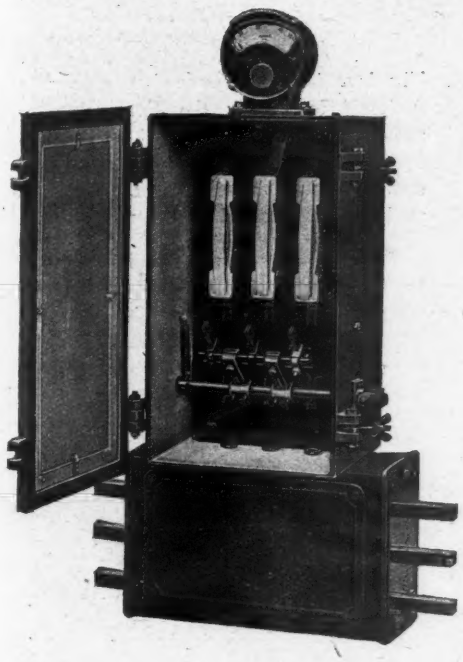


A.C. UNIT PANEL.

Complete A.C. Unit Panel, consisting of triple-pole switch with fuses designed to meet H.O. regulations.

Fitted with bus-bars and bus-bar chamber. Switch interlocked with door cover.

LONDON : 31, King Street, Covent Garden.

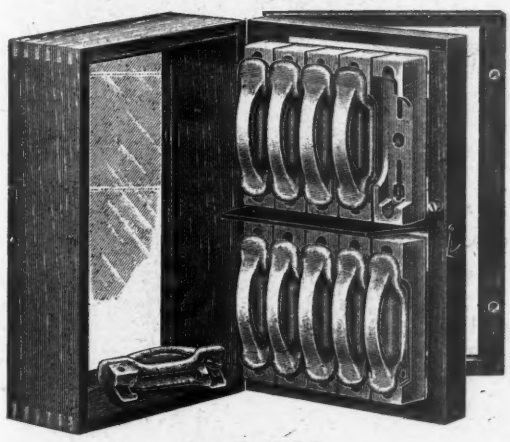
BIRMINGHAM : Carlton House, High Street.

BRISTOL : 59, Victoria Street.

MANCHESTER : Hardman Street, Deansgate

NEWCASTLE-ON-TYNE : St. Andrew's Buildings, West Gallowgate.

GLASGOW 51, Waterloo Street.



5-way Double-Pole with "Swing-Back."

Tucker "H.O." Pattern Fuse Boards . . . . .

Single- Double- or Triple-Pole . . . . . .

In Teak or Iron Cases .

All Standard Capacities. Voltages up to 500 Volts.

We make several different patterns of Fuseboards. The "H.O." range illustrated comply with the regulations of the Home Office. Accidental contact with live metal is impossible. The Board illustrated is mounted in a teak case fitted with a "swing back" attachment, which facilitates erection of the Boards and allows of easy and immediate access to the connections at any future time.

J. H. TUCKER & CO.,

KING'S ROAD, . . HAY MILLS,

BIRMINGHAM.

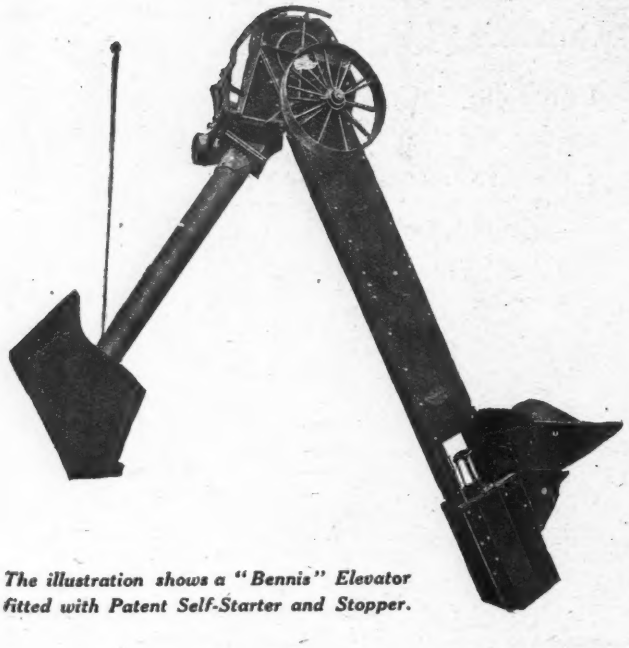
LONDON . 217, Shaftesbury Avenue, W.C.

GLASGOW . . . . 221, St. Vincent Street.

It starts itself

Bennis Conveyors

and Automatic Elevators for the rapid and economical handling of coal and ash.



The illustration shows a "Bennis" Elevator fitted with Patent Self-Starter and Stopper.

The ingenious appliance here shown is designed to render the Coal Elevator automatic in operation and thus eliminate the need for close attention. It can be applied to existing elevators as well as incorporated in the new ones.

The Elevator stops running as soon as the hoppers are full and starts itself when the shoots are about half empty. There is thus always a sufficient supply of coal, with no over-feeding and less wear and tear.

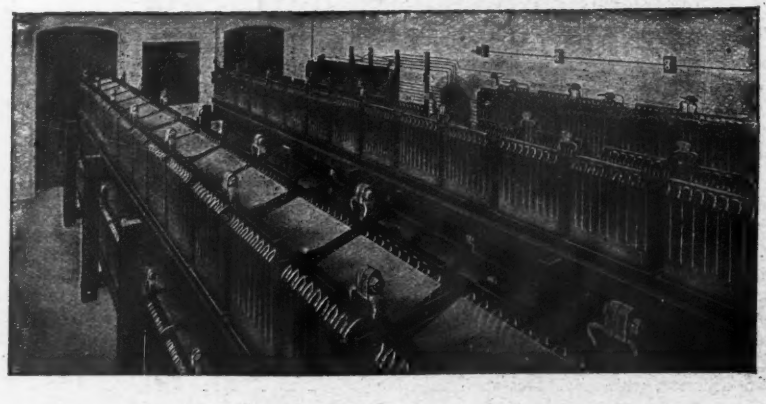
Ed. BENNIS & Co., Ltd.
LITTLE HULTON ····· BOLTON
AND 28 VICTORIA STREET LONDON SW.

HART ACCUMULATOR Co.

LIMITED,

STRATFORD, LONDON, E.

Write for Illustrated Catalogue.



HART Storage Cells suitable for all purposes.

British Made Throughout.

STORAGE CELLS FOR ALL CLASSES OF ELECTRIC LIGHTING.

THE "BANQUO" (Registered) SYSTEM.

SUPPLIED IN LARGE NUMBERS TO ARSENALS, DOCKYARDS, EXPLOSIVES FACTORIES, CHEMICAL WORKS, RAILWAYS, &c.

"Banquo" Combined Watertight Switch and 3-pin plug. Fitted with safety interlocking device.

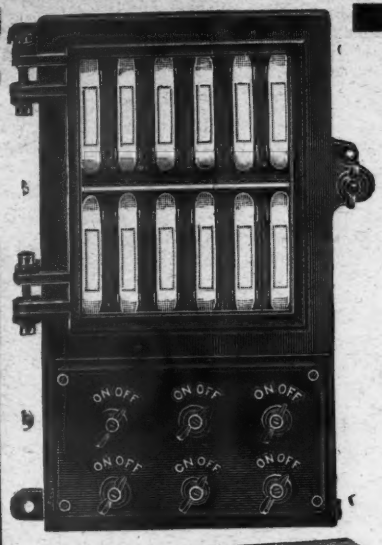
PRICES ON APPLICATION.

We manufacture a special Tough Rubber-Jacketted Flexible Cord for use with this Plug.

WATERTIGHT 5-AMP. 3-PIN PLUG.

Of Strong Construction.

Supplied in various current capacities.



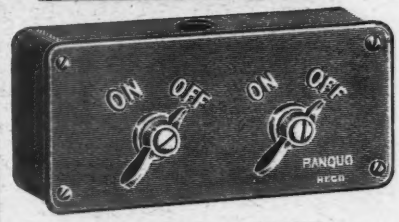
We illustrate an improved form of combined Distribution Switches and Fuse Board of the very latest and best possible type. These boards have been supplied by us on the best class of work where low price has not been a consideration, but reliability and quality the only factors. The Fuses are of our B.O.T. Sunk Type, have all current-carrying metal parts totally protected. The Switches are made up in banks according to the desired number; they are in a dust and damp-proof compartment, with the handles on the front of panel.

Full Particulars and Prices on Application.

PRICE PER WAY.

No. of Ways.	List No.	5 Amp. per Way.
2	P16/A	£1 8 0
3	P16/B	£1 6 0
4	P16/C	£1 5 6
5	P16/D	£1 5 0
6	P16/E	£1 4 0
7	P16/F	£1 4 0
8	P16/G	£1 4 0

SUBJECT TO TRADE DISCOUNT.



TWO WAYS.

"Banquo" Switches are made up in sets from one way and upwards. With gun-metal handles in watertight cases they represent the best switch-distributing system.

No. of Single-Pole 5-amp. Switches	1	2	3	4
Prices:	5/4	10/8	16/-	21/4
	5	6	7	8
Prices:	26/8	32/-	38/-	43/-

SUBJECT TO TRADE DISCOUNT

ONE WAY.

Ward & Goldstone

SALFORD MANCHESTER

Telephones: 7083-4-5-6 Central. Telegrams: "Multum," Manchester.

LONDON: ALBION HOUSE, 59-61, New Oxford Street W.C.

GLASGOW: 50, Wellington Street

ELECTRIC MOTORS.

ALTERNATING AND CONTINUOUS CURRENT.

POWER APPLICATION is a SPECIALITY with us.

Send Enquiries.

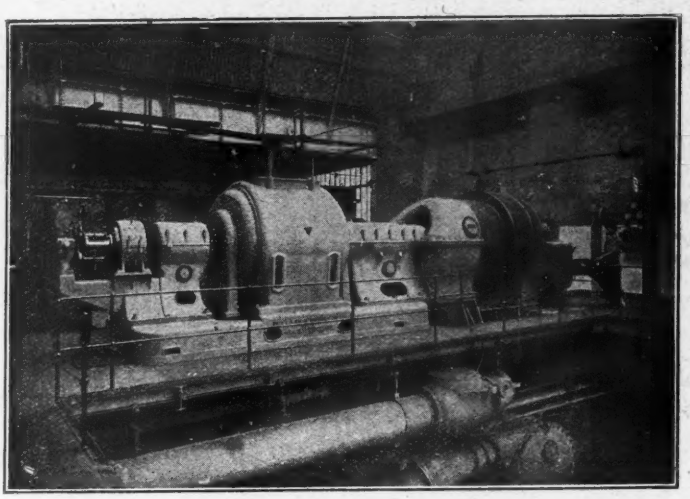
J. H. HOLMES & CO., Newcastle-on-Tyne.

VICKERS LIMITED.

Motors and Generators of all Types.

Rotary Converters.

Complete equipment for the electrical lighting and driving of Machine Shops, Factories, Mills, &c.



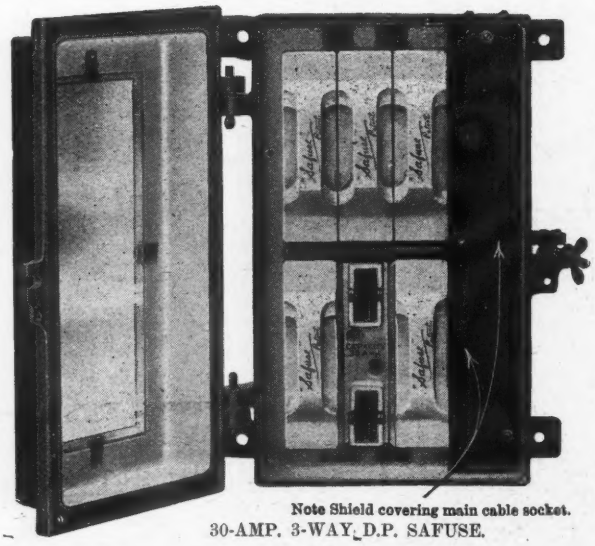
Patent Automatic Reversing Drive for Machine Tools.

Three-phase Vickers Turbo Alternator, 3,000 K.W. 1,500 r.p.m., 50 cycles.

River Don Works.
Sheffield.

DONOVAN'S SYSTEM OF PATENT SAFUSES.

COMPLY WITH ALL THE LATEST HOME OFFICE REGULATIONS.



Note Shield covering main cable socket.
30-AMP. 3-WAY D.P. SAFUSE.

THESE FUSES ARE BEING USED IN ALL THE MOST IMPORTANT MUNITION FACTORIES THROUGHOUT THE COUNTRY WHERE SAFETY AND EFFICIENCY ARE THE FIRST CONSIDERATIONS.

Write for Illustrated Descriptive Pamphlet.

PROMPT DELIVERY FOR WAR WORK.

SOLE MAKERS:

DONOVAN & CO.,

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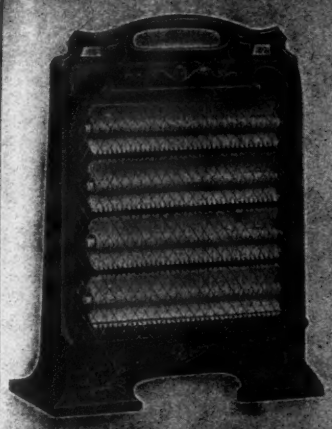
The Revo ELECTRIC FIRE

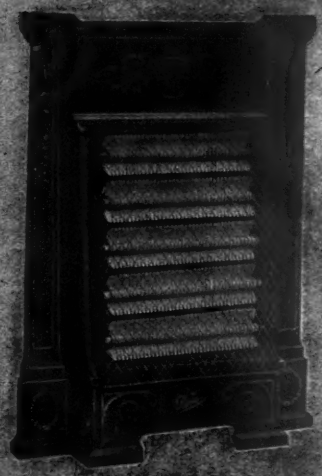
possesses several novel & valuable features all of which are protected by Letters patent No's.

24,565 / 13.
9,794 / 14.
3,513 / 15.
5,889 / 15.

All Designs are registered.



'POPULAR'
1½ to 2½ K.W.



'CASTLE'
2 to 3 K.W.

PRICES RIGHT

QUALITY RIGHT

"Revo"

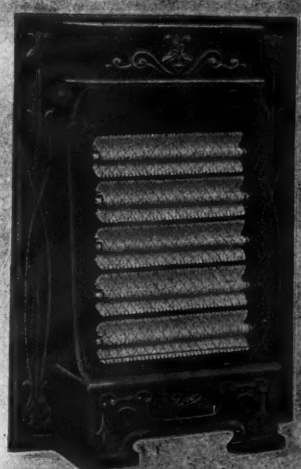
ELECTRIC FIRES

PROMPT DELIVERY

PERSONAL ATTENTION

FEATURES

Interchangeable Elements.
Instantaneous Heat. No Time Lag.
Patent Device takes up Expansion & Contraction of Elements.
Low Prices.
Beautiful Finish.
Delivery from Stock.



'LEADER'
2 to 3 K.W.

'ELITE'
2½ to 3½ K.W.

SEND FOR LATEST LIST. POST FREE.

THE CABLE ACCESSORIES Co LTD.
Britannia Works:- Tividale, Tipton, Staffs

The War and "Le Carbone" Brushes.

"Are you able to continue to supply us with Le Carbone Brushes."

"Yes."

This affirmative answer has greatly eased the minds of all our customers.

You can appreciate the full meaning of this statement only by the use of Le Carbone brushes on your machines—the use of a brush of absolute uniformity which will give you long and efficient service

Le Carbone,
17, Water Lane, Gt. Tower Street, E.C.

CRYSELCO

METAL FILAMENT LAMP

Manufactured only by the All-British Lamp Company,

CRYSELCO, LIMITED,
Kempston Works,
BEDFORD.

Telegrams: "Cryselco, Kempston." Telephone: 177 Bedford.

SUN

Avoid accidents

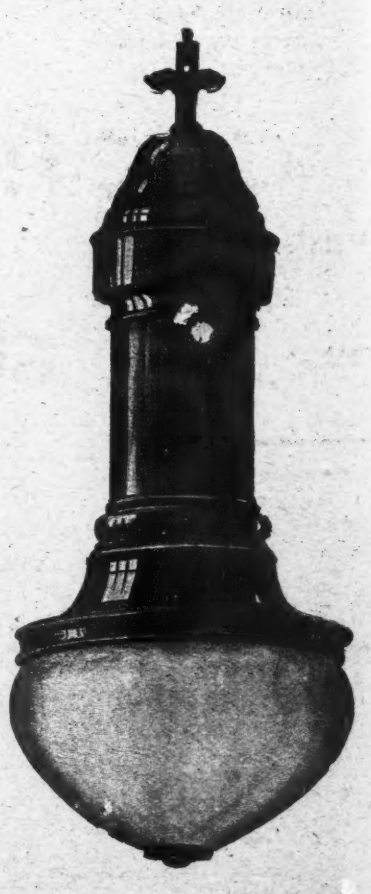
by having efficient illumination. But it must always be instantly available. In these days of short staffs the trimming, &c. of arc lamps may get delayed—with the result that the light is not there when wanted. With

HALF-WATT LAMPS IN SUN FITTINGS

however, light is always ready to hand in units up to 3,000 C.P.—no cleaning, no trimming—just switch on.

The fitting illustrated—L 1732—is weather-proof and designed for outside use. 31 inches overall it will take half-watt lamps up to 3,000 C.P. Costs less to instal, maintain and run than an arc lamp.

Let us send you List 273 fully describing this and other patterns for inside and outside use.



The SUN ELECTRICAL COMPANY LIMITED
118-120, CHARING CROSS ROAD, LONDON, W.C.

"ELLISON"

IMPROVED "VERTICAL" AND "TRACTION" TYPE

CIRCUIT BREAKERS

FOR ALTERNATING AND CONTINUOUS CURRENT UP TO 700 VOLTS.

The Special Features of these Breakers are:—

1.—All parts are perfectly standardised and completely interchangeable.

2.—The breaks are exceptionally long and quick.

3.—All contact parts are readily renewable.

4.—The carbon arcing contacts are the self-cleaning sliding contact type, and rapid closing cannot damage.

5.—Only one shape and size of carbon is used throughout, and the number employed is proportional to the current.

No. 1 SIZE.

Single-pole Open Type Breaker, with Standard Bell Contactor, to close simultaneously with Breaker. Straight Type Handle and Overload Release.

6.—Good copper to copper contact is maintained at adequate sparking tips while the brush is leaving the contact block, and pitting cannot occur.

7.—The contact surfaces and cross-sections are ample.

8.—All live parts of the Breakers are insulated from the frames, levers and adjustment tubes.

9.—Adjustable Time Lags are fitted when required.

GEORGE ELLISON,

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MANCHESTER: 4, CANNON STREET.

VICTORIA WORKS, WARSTONE LANE,

BIRMINGHAM.

LEEDS: STANDARD BUILDINGS, CITY SQUARE.

GLASGOW: 221, ST. VINCENT STREET.

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E. SHOWELL & SONS,

LIMITED,

STIRCHLEY, BIRMINGHAM.

CAST

CABLE SOCKETS.

Suite E74.

Made in all sizes.

Type A. STRAIGHT. Type B. OFFSET. Type C. RIGHT ANGLE.

ILLUSTRATED DIMENSIONED SHOWCARD FOR DRAWING OFFICE USE supplied free on application.

Sole Agent for Electrical Trade:—LIONEL ROBINSON, 3, Staple Inn, London, W.C. *Telephone: Holborn 6323.*

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THE MARK OF QUALITY

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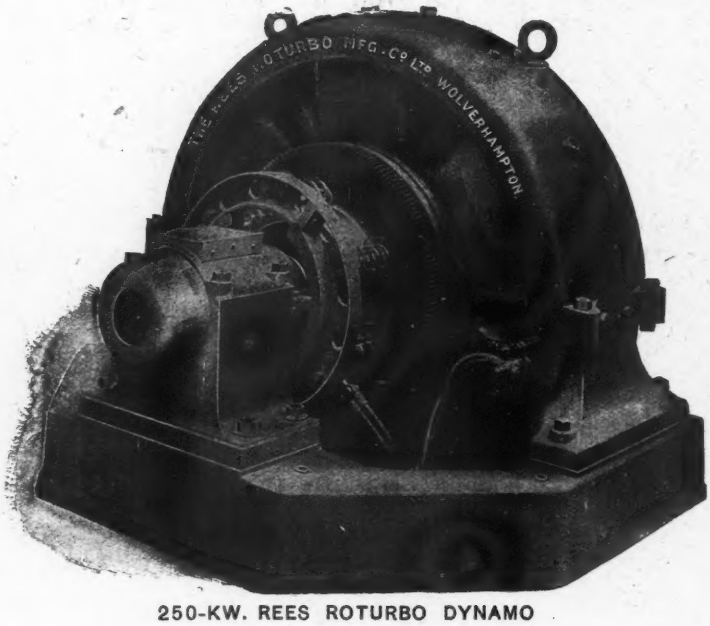
THE REES ROTURBO MFG. CO., LD.,

WOLVERHAMPTON, ENGLAND,

PUMPING AND ELECTRICAL ENGINEERS.



250-KW. REES ROTURBO DYNAMO
For ENGINE OR GEARED TURBINE DRIVE.

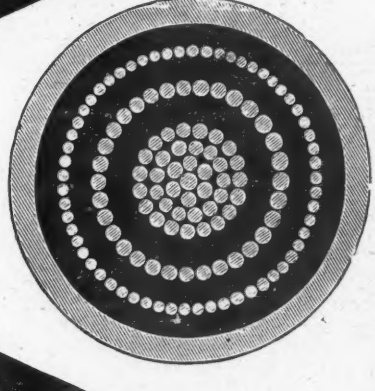
STANDARD
D.C. MOTORS
AND
DYNAMOS
FOR QUICK DELIVERY
Up to 100 B.H.P.

REES ROTURBO TRADE MARK

LONDON OFFICE:
Hastings House,
NORFOLK STREET,
STRAND, W.C.

"LIVERPOOL"

ELECTRIC WIRES & CABLES



LONDON:
BAXTER & GAUNTER, Ltd.,
219, Tottenham Court Road, W.

MANCHESTER:
H. G. MABBS,
Marble St., Spring Gardens.

LEEDS:
LOXLEY & CO., Ltd.,
20, Basinghall Street.

NEWCASTLE-ON-TYNE:
ROBERT BOWRAN & CO., Ltd.,
St. Nicholas Buildings.

GLASGOW:
A. & J. M'CULLOCH,
140, West George Street.

IRELAND:
F. A. PORTER,
13, Queen's Square, Belfast.

LIVERPOOL ELECTRIC CABLE CO., LTD.,

Head Office & Works: **LINACRE LANE, BOOTLE, LIVERPOOL.**

Telephone No. 542 Bootle. Telegrams: "Concentric, Liverpool."

Ward & Goldstone

SALFORD MANCHESTER

Cotton and Silk-Covered Wires. Fine coverings specialised.

Automobile armoured Lighting and High and Low Tension Wires.

Asbestos covered Wires.

Resistance Wires wrapped on asbestos cording.

Shot-firing Cables of every class.

All types of telephone receiver and transmitter cords.

Telegrams: "Multum," Manchester.

Telephones: 7083-4-5-6 Central.

Established a quarter of a century.

MANUFACTURERS OF EVERY CLASS OF INSULATED WIRES AND CABLES.

Special attention devoted to Enquiries from the Colonies.

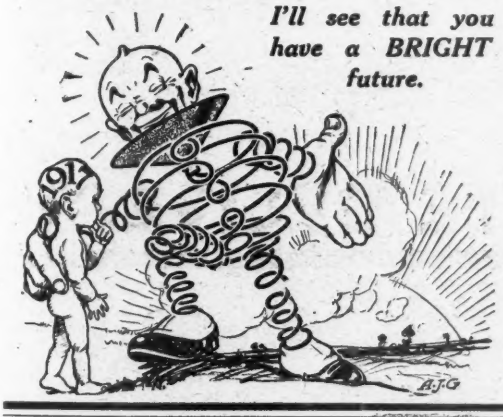
Bell Wires, tinsel and detonator wires.

Flexible Cords for lighting, power, heating, bell and telephone use.

Tough rubber-jacketted Flexible Cord.

Telephone Cables for inside and outside use, with I.R. vulcanized rubber, enamelled, paper or bitumen insulations.

Braided Wires and Cords of all types to suit every electrical requirement.



I'll see that you have a BRIGHT future.

Here's the way to a Prosperous New Year.

POPE

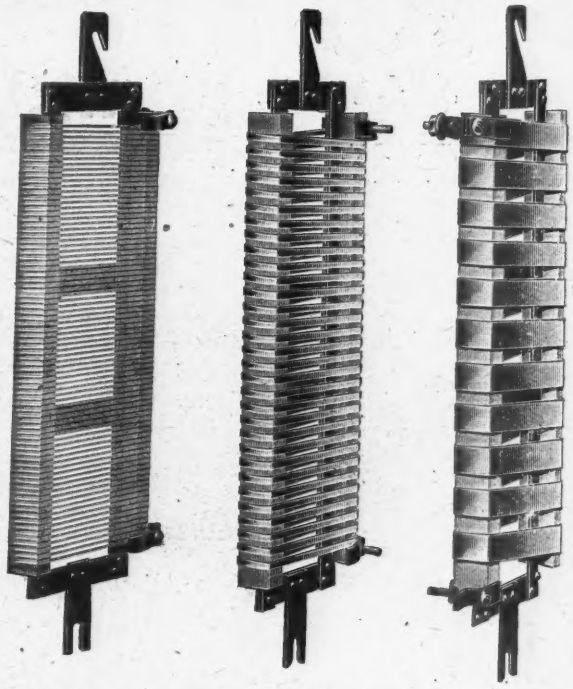
'ELASTA'

WIRE LAMPS

Noted for Strength. Brilliance. Economy.

Advt. of Pope's Electric Lamp Co., Ltd., Hythe Road, Willesden, N.W.

RHEOSTATS



LIST ON REQUEST.

ISENTHAL & CO.,

(DEPARTMENT 3),

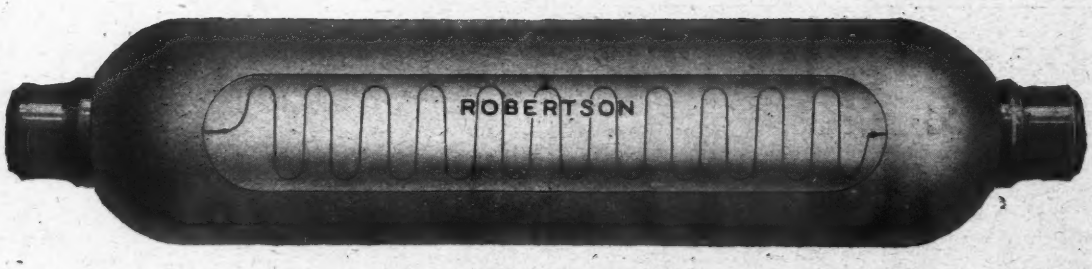
Denzil Works, Willesden, London, N.W.

Robertson Heating Lamps

VERTICAL TYPE.

BRITISH MADE THROUGHOUT.

IMMEDIATE DELIVERY



HORIZONTAL ZIGZAG TYPE.

The General Electric Co., Ltd.

Head Office: 67, Queen Victoria Street, London, E.C.

Telephones: London Wall No. 3600 (30 lines). *Telegrams: "Electricity, Cent., London."*

Branches:—Manchester, Birmingham, Glasgow, Cardiff, Newcastle, Dublin, Belfast, Bristol, Swansea, Liverpool, Leeds, Sheffield, Nottingham, Hull, Southampton, Cork and Aberdeen, &c.

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THE "ELECTRICAL REVIEW"

CHEAP PREPAID ADVERTISEMENTS

Relating to Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of ONE PENNY per Word (minimum 1s.). Box Number and "Electrical Review" Address count as Seven Words.

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By J. W. WARR, A.M.I.E.E.

60 ILLUSTRATIONS.

An invaluable book for the Motorist and Motor Cyclist. **2s.** net. Post Free **2s. 2d.** Of all Booksellers and of the Publishers—

H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, London.

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can be obtained through

WHEATLEY KIRK, PRICE & CO.

(Established 1850).

46, Watling Street, London, E.C.

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A M.I.E.E., A.M.I.C.E., A.M.I.M.E., Matriculation, B.Sc. (Engineering), Assoc. Mining Elect. Engrs., secured with minimum expense and energy by "U.E.C." Individualised Correspondence Courses. Advice and guidance *free*.—Apply Advisory Secretary, UNIVERSITY ENGINEERING COLLEGE, 3, St. Mark's Crescent, Regent's Park, London, N.W. (Five advertisements below.) 1556

CORRESPONDENCE Courses in Civil, Electrical, and Mechanical Engineering. Specially *Reduced* Fees during the War! Success *guaranteed!* — UNIVERSITY ENGINEERING COLLEGE. (Advertisements above and below.) 1557

ELECTRICAL Engineers desiring *early* advancement will be well advised to send *at once* for the "U.E.C." Prospectus, see UNIVERSITY ENGINEERING COLLEGE advertisements, above and below. Special Courses for *Assistant Engineership*—G.P.O. 1558

FREE!! Send *immediately* for "U.E.C." Prospectus of Specialised Engineering, Mathematical and Examination Training. Unique System! Record series of successes.—UNIVERSITY ENGINEERING COLLEGE. (Advertisements above and below.) 1559

MATHEMATICS effectively mastered by the "U.E.C." *practical* Correspondence System. The *most profitable investment* on market. *Commercial Engineering*, Works Management, Installations, Electrical Design, Draughtsmanship, &c.; UNIVERSITY ENGINEERING COLLEGE advertisements numbered 1556, 1557, 1558, 1559, 1561. 1560

WANTED Engineers—to fill responsible positions in the Trade Boom ahead! *Think!! Are you qualified?*—Let "U.E.C." particularly advise and quote you *free* concerning Course of Spare-Time Training to most profitably develop *your* abilities.—Write now to UNIVERSITY ENGINEERING COLLEGE. (Five Advertisements above.) 1561

SITUATIONS VACANT.

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If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

A MAN with electrical and engineering training, take turn night and day in working and maintaining a country generating station; steady, willing to do odd jobs; Diesel (Mirrlees), steam and water.—Apply stating age, salary, with full particulars and experience, with copies of references, to ELECTRICITY GENERATING WORKS, Tadcaster, Yorks. 1539

ARMATURE Winder required to take charge of small department in Westminster. No person resident more than ten miles away, or already engaged on Government work, will be engaged.—Apply W. G. WALKER & Co., Emery Hill Street, Victoria Street, S.W. Phone: Vict. 1622. 6715

ASSISTANT Electrical Engineer required for the Government Electric Light Department, Federated Malay States, for three years with possible extension. Age 25/30, preferably single. Salary £360—£15—£390, with duty allowance of £75 per annum. Free passages. Half salary during voyage out. Duties will include charge of a water power station. Must have good all-round experience with three-phase E.H.T. and direct current, together with good knowledge of Pelton water turbines. Should be Associate Member of Inst. of Electrical Engineers.—Apply at once, by letter, giving full particulars and forwarding copies of recent testimonials, to Messrs. PREECE, CARDEW, SNELL & RIDER, 8, Queen Anne's Gate, quoting M/F.M.S. 8130. No person eligible for the Army, or engaged on Government work, need apply. 6705

ASSISTANT Engineer, experienced, keen, required immediately. 3-phase H.T. station, Diesel oil plant, mains work, station and office records.—Address, RESIDENT ENGINEER, Electricity Works, Sundridge, Sevenoaks. 1572

DRAUGHTSMAN wanted, with experience in mechanical design of electric motors and control gear.—Apply, stating qualifications, age and salary required, and when could commence, to MESSRS. HARLAND & WOLFF, LTD., Belfast. 6702

ELECTRICAL Wiremen wanted for Government work. Ex-Army or Naval men given preference, even if slightly incapacitated. Standard rate and bonus. Yorkshire town. No men already on Government work will be engaged.—Apply nearest EMPLOYMENT EXCHANGE, quoting A 2636. 6691

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

ELECTRICIAN capable of taking charge wanted, also Wiremen. State age, wages and experience.—Apply TROON MOTOR GARAGE CO., LTD., Troon, Scotland. 1541

EXPERIENCED Platelayers (ineligible) required for South Coast Tramways for repair work.—Apply stating wages required, and giving full particulars and experience, &c., to 6698, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

GOOD all-round Electrical Mechanic (age between 45 and 60), or a younger man who is ineligible for military service or munition work, required immediately to take charge of electrical installation of 1,250 points, as well as arc lamps and motors; current supplied from borough. Man used to wiring, and capable of arc lamp and battery maintenance and general electrical repairs; appointment for duration of war; wages 52s. per week of 52 hours, and overtime when necessary, at 1s. 3d. per hour.—Apply by letter, stating age, experience, and with copies of not more than three recent testimonials, to Professor J. T. MORRIS, M.I.E.E., East London College, Mile End Road, E. 1551

OUTSIDE Representative required by large firm of manufacturing electrical engineers for Lancashire and/or West Riding District. Must have well-established live connection among contractors and large consumers; salary and commission. Must be ineligible for military service.—Apply with copies recent testimonials, stating age and particulars of experience, to 6638, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED for South Coast Tramways, an Electrical Wireman, thoroughly conversant with tramcar controllers and motors, wiring, &c.; wages 10d. per hour, with overtime at the usual increased rates. Must be ineligible for service.—Write, giving full particulars, to 6697, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SHIFT Engineer wanted (London district) with experience in the running of large generating stations; 56-hour week. State experience fully and give age. Only those ineligible for H.M. Forces, and who can be released by present employers, to apply. Pay 67s. to 77s. per week according to abilities.—6689, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SUB-STATION Attendant wanted in S.W. London area. Wages, 36s. per week, plus war bonus. Three 8-hour shifts worked. Must be ineligible for military service.—6641, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TELEPHONE Tester wanted, to test intercommunication instruments for electrical and mechanical faults; permanency for ineligible man.—Apply to THE TELEPHONE MANUFACTURING CO., LTD., Hollingsworth Works, Martell Road, West Dulwich, S.E. 6690

TRANSFORMER Tester wanted at once. No person already engaged on Government work need apply.—Apply nearest EMPLOYMENT EXCHANGE, quoting 6700, ELECTRICAL REVIEW, giving particulars as to age, wage, experience, and position regarding military service.

TRAVELLER required for Yorkshire for Electric Wires and Cables; salary and expenses.—State full particulars, also salary required.—1534, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

TWO Electricians, accustomed to large factory D.C. plant; should be capable of doing all classes of repair work in connection with generators, motors and accessories, testing, &c. Good permanent job.—Apply stating age, wages required, with copies of references, to THAMES PAPER CO., LTD., Purfleet, Essex. 6685

WANTED, a Pump Room Foreman used to large output. Government work; good wages. No person engaged on Government work will be engaged.—Apply nearest LABOUR EXCHANGE, quoting No. A2585. 6484

WANTED, Assistant Shift Engineer with good mechanical training for London power station. Wages up to £3 per week, depending on experience. Must be ineligible for military service.—Write full particulars to "N. K.," c/o Street's, 30, Cornhill, E.C. 1573

WANTED, by a firm in the S.E. district engaged on munition work, first-class Telegraph Mechanics. No person resident more than 10 miles away or already engaged on Government work, will be engaged.—State age and experience to 6125, ELECTRICAL REVIEW, 4, Ludgate Hill, London

SITUATIONS VACANT.—*Continued.*

WANTED, Colliery Electrician, working, used to A.C. and D.C. plant and signals and telephones.—State age, wage, experience, when at liberty, 1567, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Engineer-Designer for motor-car ingnition apparatus, car lighting and starting systems; must be thoroughly expert and up-to-date in latest English and American systems, with knowledge of modern methods of manufacture, able to design jigs, &c.—Write stating age, experience and salary, to 6706, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for duration of war, young Electrical Engineer Able to modernise old, and lay out new small lighting and power schemes.—Apply, giving full details of experience and salary required, to 6695, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED immediately, Chaffeur-Mechanic, ineligible, Lanchester & Wolseley cars. Willing to take charge of electric light plant and oil pump engine. Good wages with cottage, and boy to help.—MRS. F. M. BUTLER, Carswell Manor, Faringdon, Berks. 1570

WANTED, Improver in H.T. A.C. Municipal Station (not eligible).—State age, wages and experience, to F. R. WINDSOR, Generating Station, Monmouth. 6286

WANTED, Installation Foreman and Meter Reader (combined) for Electric Supply Co., London. Must be ineligible. Wages 40s to 45s., according to experience.—6714, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Two Shift Engineers for Power Station, D.C. and H.T., three-phase: ineligible. Salary 40s. to 50s. per week. —CHESHAM ELECTRICITY WORKS, Chesham, Bucks. 1535

WIREMAN-Jointer required, accustomed to all service work and jointing paper cables, Callender's system. Also able to attend to consumers' complaints, motors, &c. Some central station experience a recommendation. Ineligible, ex army man preferred. Wages 40s., plus 2s. war bonus.—Apply ENGINEER, Electricity Works, Bridlington. 6694

APPOINTMENT FILLED.

WE beg to state that the position advertised under Box No. 6454, November 17th, 1916, for Man to take charge under Station Superintendent, has now been filled. 6703

SITUATIONS WANTED.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

ADVERTISER, English, shortly disengaged, returning to England, desires responsible position. Twenty years' thorough practical, technical and commercial training with English and Continental manufacturers. Good French and German. Exceptional experience overseas trade in Japan, China, Australasia, Russia, South Africa; would prefer undertake control and organisation export department for post-war campaign. Moderate commencing salary and commission on results obtained.—1506, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

DRAUGHTSMAN, Junior (17), general and electrical drawing office and works experience; London district (res. N.E.). Refs.—1465, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (32, married, two children), on munitions in India: services available March, 1917. Manufacturing, installing and running experience in practically all branches of the application of electricity. Last two appointments staff billets. World-wide experience; first-class references. Foreign agency preferred.—1505, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ENGINEER-in-Charge wants change, ineligible; used to H.T. D.C. machines, accumulators; all repairs. First-class Board of Trade Certificate. 7½ years' chief, marine Lancashire boilers, Underfeed stokers, economisers, calorifiers.—1544, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Position by an Electrical and Mechanical Engineer, all-round experience; experience abroad. Age 27.—6707, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

SCANDINAVIA. Export—Import.

NORWEGIAN COMPANY, well-established amongst Scandinavian electrical concerns and plants, is now open to negotiate terms of Agencies of high-class and reputed manufacturers of Generators and Motors, Transformers, Switchgear, Hydraulic Turbines, Governors, &c. Best references will be furnished upon request.—Apply to "Export—Import, 954," c/o Ohmes Advertising Agency, Kristiania, Norway. 1576

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CABLE Agency required for South Wales district by well-established engineering firm.—1568, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

LONDON Electrical Firm, having West End Showrooms and Offices, desire to correspond with manufacturers with a view of taking up new Electrical Novelties, Medical and Dental Appliances or new inventions; fullest detail particulars.—1510, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR SALE.

MACHINERY FOR SALE.

DIRECT-CURRENT MACHINES.

One 15-H.P. B.T.H. Motor, 460 v., 1,280 revs.
One 15-H.P. Cuttings Motor, 440 v., 1,000 revs.
One 5/6½-H.P. "Zone" Motor, 400/500 v., 1,450/1,650 revs., direct coupled to 3" Pulsometer Pump, 40 ft. head, 220 gallons per minute.
One 5½-H.P. Phœnix Motor, 220 v., 600 revs.
One Industrial Dynamo, 82 amps., 220 v., 750 revs.
One Lancs. Dynamo Co. Dynamo, 70 amps., 230 v., 560 revs.
One Royce Dynamo, 130 amps., 220 v., 800 revs.
One 40-H.P. Lancs. Dynamo Co. Motor, 120 v., 700 revs.
One 80-H.P. Westinghouse Motor, 110 v., 600 revs.

ALTERNATING-CURRENT MOTORS.

One 200-H.P. Electric Construction Motor, slip ring, 400 v., 3-phase, 50 periods, 415 revs.
One 25-H.P. Wright & Woods squirrel-cage Motor, 400 v., 3-phase, 50 periods, 580 revs.
One 10-H.P. Mather & Platt Motor, squirrel cage, 500 v., 3-phase, 50 periods, 570 revs.
One 10-H.P. Brooks Motor, 400 v., single-phase, 50 periods, 950 revs.
Twenty ⅓rd-H.P. Westinghouse Motors, 200 v., single-phase, 50 periods, 1,400 revs.

We have Starting Gear for all above Machines.
Other Machines in stock. Send your enquiries.
BURY ELECTRICAL PLANT CO., Castle Grounds, Bury. 6647

COUNTY BOROUGH OF BOURNEMOUTH.

For Sale.

TWO 2-cylinder compound direct-coupled Belliss-Siemens Steam Dynamos, 225/235 volts, 192 amps., full load developed at 80 lbs. steam pressure, exhaust to atmosphere, with spare armature and switchboard. All in excellent condition.
Can be viewed at any time.
Offers (which will not necessarily be accepted) for either one or both, to be sent to—

F. P. DOLAMORE,
Borough Engineer.

Municipal Offices,
Bournemouth,
23rd December, 1916. 6704

FOR SALE.—*Continued.*

FOR SALE.

160-KW. Generating Set, two-crank Compound Engines, three-phase Alternator, 550 volts per phase, 174 amps., 40 cycles, 30 revs.
Two Electric Locos., 2' 6" gauge, 30/35 tons, at a speed of 5/6 miles per hour.
Triple-geared Boring and Chucking Lathe, by Robertson and Co., swing 5' 4", internal geared chuckplate, 4' 1" diam.
Two double-geared 24" Swing Chucking Lathes, by Dean Smith & Grace.
No. 17 Alfred Herbert Combination Chucking Lathe.
Side-Planing Machine, by Geo. Richards, Broadheath, bed 8' long; two T-slotted tables with trays.
Richards' Patent Piston Rod-Grinding Machine, take rods up to 4' 9" long.
Double-Geared Screwing Machine, by Dron & Lawson; 3½" hollow spindle, bed 8' long.
9" Stroke Geared Slotting Machine.

CATALOGUE of Stock MACHINERY. 2-3000 LOTS.
Free on Application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

R. H. LONGBOTHAM & CO., LTD., WAKEFIELD,

and at Milburn House, Newcastle-on-Tyne.
Tel: { 44 Wakefield. / 867 Newcastle. Telegrams: "Engineer, Wakefield."

FOR SALE.

ONE Parsons Steam Turbo Set, 3,500-KW., 1,200 R.P.M., with alternator field-rotating type and exciter complete; 6,000-volt maximum load, 40 cycles, condensers and three-throw type air-pump, driven by 3-phase motor.
350-KW. Alternator, by the B.T.H. Co., 550 volts, 3-phase, 50 cycles, with Barclay's cross compound horizontal Engines, 26" and 40" cyls. × 4-ft. stroke.
Two "Westinghouse" Motor Generating Sets, 300-H.P. Motors, 3-phase, 40 cycles, 480/500 volts; Generators 200 KW., D.C. compound wound; each set on separate soleplate.
240-KW. 3-phase Alternator, 2,200 volts, 40 cycles. Up to date and in excellent condition.
Generating Set, comprising 3-crank compound engine, dynamo by Siemens, 2-pole, 500 volts, D.C.
One 80-H.P. Phœnix Motor, A.C., 625 volts, 40 cycles, 3-phase, 290 R.P.M. 5277

ENGLISH CHINA CEILING ROSES.

SOLID Cast Brass Block Terminals fitted with Nettlefold's cut screws (no thin stampings or rolled screws), 40s. per gross. Sample 3 doz., 10s. 6d. Carriage paid if cash with order.
BIRMINGHAM ELECTRICAL ACCESSORIES MFG. CO., LTD.,
Whitmore Street,
Hockley, Birmingham. 6221

ARC LAMP CARBONS.

LARGE Stocks. 18 and 12 m/m Cored and Solid, 8" and 12".
13 m/m Cored and Solid.
11 m/m Cored and Solid.
7 and 8; 8 and 9; 9 and 10; 10 and 11.
Flame Carbons, and all standard types.
M. O. HECKELS, Pearl Buildings, Newcastle. 1503

ELECTRIC MOTORS.

SALE or hire. Second-hand Machines in stock. ARMATURES and Coils repaired at shortest notice.
THE TITAN ELECTRICAL CO.,
9/11, Eagle Street, W.C.
'Phone: Central, 13,191. 6493

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TRADE RATES ON APPLICATION.
Box Number and ELECTRICAL REVIEW address count as seven words.

A.E.G. Arc Lamps. Stock of spare parts.—Send full particulars of your requirements.—1528, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CARBONS.—Offers wanted for 25,000 13, 15, 16, 17, 18 and 22 m/m cored and solid Carbons. List on application.—PHŒNIX ELECTRICAL CO., 32—36, Broomielaw, Glasgow. 6713

(Continued on next page.)

FOR SALE.—*Continued.*

DYNAMOS, 3000, 1500, 1000 and 750 amperes at 6 volts; also smaller sizes. Machines let out on hire.—CANNING & Co., Electro-Platers' Engineers, Birmingham. 7769

ELECTRIC Motors and Dynamos, Sale or Hire. Always a large stock of nearly new guaranteed machines. Immediate delivery.—ELECTRO-GENERATOR Co., 1A, Shepherd's Bush Road, W. 'Phone: 488 Hammersmith. 1128

ELECTRIC overhead Travelling Crane, 45-ft. span. Cheap.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6712

FIVE Marble Panel Starters, complete with ampmeters; French make; suitable low voltage; ranging 6-10 H.P.; in good condition. 43 Ebonite Accumulator Boxes, 5" by 4¼" by 10¾" high. What offers to clear.—S. HARRIS, 41, Ash Road, Stratford. 1523

FOR Sale, Engine Set, comprising 32-B.H.P., 4-cylinder engine and dynamo to give an output of 180-200 amperes at a speed of 850 R.P.M.; engine by New Pelaphone Engine Co.; Wright and Wood dynamo; practically new; not run 100 hours; what offers? —BAMFORTH & Co., LTD., Holmfirth, Yorks. 1555

FOR Sale, large quantity Miscellaneous Switchgear, Switchboards, Instruments, &c., &c. Inquiries solicited.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6662

FOR Sale or Hire, high class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 1569

FOR Sale, Three 10-B.H.P., 460-volt, 1,000-R.P.M. Crompton Motors, new; immediate delivery.—N. & F., LTD., 31, Budge Row, E.C. 6676

FOR Sale, two 12-H.P., 220-volt protected type shunt-wound "P.D.M." Motors, complete with starting gear and spare armature. — PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6661

FOR Sale, 45-KW., 220-volt Allen Generating Set, comprising enclosed forced-lubrication engine with cylinders 8½" and 15" × 7" stroke, 350 R.P.M., direct coupled to shunt-wound dynamo on extended bedplate, suitable for steam at 100-130 lbs. This set is now running, and is complete with separator, stop-valve, impermeator, steam and oil pressure gauges, tachometer, and shunt regulator.—Further particulars and price from F. WESTLAKE PARKINSON, M.I.E.E., 16, Chichester Street, Belfast. 1543

FOR Sale, 50-H.P., 3-phase, 220 volts, 50 cycles; 4 H.P., 240 volts. 3-H.P. Buffing Motor, 240 volts. 15-H.P. 220-volt, 3-KW. Generator, Switchboard, cheap. Three 20-H.P., D.C. 480; Two 70-H.P., 480; 6-H.P., 440-volt, 40-cycle, 3-phase.—BRITISH ELECTRICAL SUPPLY STORES, Whitley Bay. 1519

FOR Sale, 110 and 200-KW., 230-volt, direct-coupled Generating Sets, with Belliss compound Engines; seen under steam by appointment. — Further information on application to 6652. ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MOTOR-Generator, 4 kilowatts, 460 to 110 volts, 800 R.P.M., Rees Roturbo, D.C.—MARTINS, 320, Witton Road, Birmingham. 1548

MOTORS for immediate Sale.—52 H.P., 2700 volts, 800 R.P.M., three-phase, 40 periods (by Scott & Mountain); 35 H.P., 600 volts, 950 R.P.M., three-phase, 40 periods (by Scott & Mountain); 10 H.P., 205 volts, 1300 R.P.M., D.C. (by Sunderland Forge Co.); 3½ H.P., 200 volts, 515 R.P.M., D.C. (by B.T.H.); 2 H.P., 500 volts, two-pole (by Scott & Mountain); ⅔ H.P., 100 volts, two-pole (by Scott & Mountain). Excellent working condition and cheap.—JENNINGS, West Walls, Newcastle-on-Tyne. 5520

SEVEN Simplex Ampere Meters, nearly new: three 75 amps., one each 200, 100, 50, 35 amps. Offers wanted. — 1574, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SEVEN 1-H.P., 110-volt Motors, 1200 R.P.M., new.—MARTINS, 320, Witton Road, Birmingham. 1426

FOR SALE.—*Continued.*

THREE-Phase Motors: 220 volts, 7½-H.P., £30. 20-H.P., £50. 500 volts, 10-H.P., £37. 35-H.P., £110. All slip-ring type; 50 periods. — PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6659

THREE-Phase Motors, 440 volts, 25 periods, 5, 10, 15, 25, 30, 50, 60, 150 and 300 H.P., all complete with starting gear and mostly of Westinghouse make.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6654

TWO 20-H.P. and three 9-H.P., 220-volt, motors. — MARTINS, 320, Witton Road, Birmingham. 1477

20-H.P. Crompton Motor, 440 volts, 1000 R.P.M.—MARTINS, 320, Witton Road, Birmingham. 1533

25-H.P., 220-volt, D.C., Lancashire Dynamo Co.'s Motor, 750 R.P.M.; complete.—THE VICTORIA ELECTRIC PLANT Co., Spenser Street, Westminster, S.W. 6629

26 Jandus Arc Lamps (2 in series 190/220 V.D.C., 2,400/4,000 C.P.), with spares; new condition. Changing over to A.C. only reason disposal.—WILLIAM ASQUITH, LTD., Halifax. 6686

40-H.P., 220-volt Motor, shunt wound, 870 R.P.M.—MARTINS, 320, Witton Road, Birmingham. 1425

45-KW. Generating Set, high-speed vertical Engine coupled to D.C. Generator, 500 volts.—HARRY H. GARDAM & Co., LTD., Staines. 6321

100-KW., 115-volt, 600-R.P.M., Multipolar Compound three-bearing Generator, by the Electrical Construction Co. Cheap.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6709

110-KW., 220-volt, 3-bearing, direct-current Generator. Cheap.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6711

120-H.P. Electric Motor, 400/480 volts, C.C., 550 R.P.M., pulley, slide rails, starting gear. Can be seen here.—VICTORIA ELECTRIC PLANT Co., Spenser Street, Westminster, S.W. 6628

200-H.P., 440-volt, 50-period, 3-phase, slip-ring type Motor, complete with starting gear. Price £325.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6710

220-VOLT, D.C. Motors. — 10-H.P., £32; 15, £40; 20, £45; 25, £50; 30, £70; 35, £75. Many others.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6708

220-VOLT Motors: 20-H.P., totally enclosed, compound wound, £50. 25-H.P., series wound, £45. Complete with controllers.—PHŒNIX ELECTRICAL Co., 32—36, Broomielaw, Glasgow. 6660

300-H.P. Generator, 6-pole, compound, by Scott & Mountain; volts, 550; amps., 400; revs., 400; 3 bearings, grooved pulley, slide rails and new spare armature. Cheap. 150-KW., A.C., 3-phase Generator, by Lancashire Dynamo Co.; 500/550 volts, 50 periods, 750 R.P.M., with direct coupled exciter, slide rails and switchboard. Cheap. — ROBERT WALKER, 2, Oswald Street, Glasgow. 6609

300-KW. Generator, by Westinghouse, 500 volts D.C., 320 R.P.M., three-bearing machine, with rope pulley.—HARRY H. GARDAM & Co., LTD., Staines. 6642

ARTICLES WANTED.

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ACCUMULATORS wanted for refining purposes. Obsolete Generating Sets, Dynamos, Motors, and all kinds of Machinery. Scrap Cable, Arc Lamps, Meters, Metal Residues, and Scrap Metals of every description purchased for prompt cash, town or country.—Apply A. BROWN & SONS, 142, Lower Clapton Road, London, N.E. Telephone, Dalston, 555. Telegrams, Secondhand, Lowclap, London. Established 1860. 42

(Continued on next page.)

ARTICLES WANTED.—*Continued.*

A.C. and D.C. Motors (second-hand) any type, any condition, wanted for prompt cash.—A. LEAROYD & SON, Bridge Works, Heatherley Street, Clapton, N.E. 1178

A. LEAROYD & Son, Bridge Works, Clapton, N.E.—Telephone Dalston, 2278; Telegrams: Frangible, Lowclap, London—buys for prompt cash every description of secondhand Generating Sets, Accumulators, Motors, Transformers, old Arc Lamps, Meters, Cable, Scrap Metals, Metallic Drosses, &c., &c. Enquiries solicited. Established over 50 years. 1179

ALL kinds of disused Plant, Machinery, Scrap Metals, &c., purchased for cash. If you have any Generating Sets, Motor Dynamos, Steam Engines, Boilers, &c., you wish to dispose of, kindly offer same to us. Complete works purchased for dismantling.—HARRY H. GARDAM & Co., LTD., Staines. Telephone, Staines 98. 8579

DYNAMOS, Motors, Arc Lamps, Meters, Scrap Cable, Iron Metals or machinery, purchased for cash in any quantities.—J. HYAMS, 11, Glengall Terrace, Old Kent Road, S.E. Telephone: 3339 Hop. 1494

PLATINUM in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

WANTED, D.C. direct-coupled Generating Set, 150/180 KW., 110/120 volts, steam 120 lbs. pressure.—MORTIMORE, LYON AND Co., 17, St. Ann's Square, Manchester. 1512

WANTED, Dynamos and Motors, A.C. or D.C.—MARTINS, 320, Witton Road, Birmingham. 1427

WANTED, Generating Set, 200 to 400-KW., 240 volts, D.C., compound-wound dynamo, preferably Belliss engine, 135 lbs. superheated.—Full particulars to S. CLIFFORD TEE, 50, Moorgate Street, London, E.C. 6668

WANTED, Generating Sets, all sizes, Boilers, Accumulators, Dynamos, &c., for export; also Scrap Cable and Metals. Complete plants purchased.—WILLIAMS & SONS, 37, Queen Victoria Street, London. Telephone, 3938 City. 7000

WANTED, Reducing Gears for Motors, 10 to 15 H.P.—MARTINS, 320, Witton Road, Birmingham. 1532

WANTED, small three-phase Alternator, 220 or 440 volts, 50 periods, about 15 KW.—Send full particulars to Box "E," Kidd's Advertising Agency, Number Thirteen, Middlesbrough. 1542

WANTED, 50-KW., D.C. Dynamo, with or without steam engine, 230 volts. Also small portable electric drilling machine, 220 volts.—1571, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARTICLES WANTED.—*Continued.*

WANTED, 2-H.P., D.C. Motor, 200 volts, in good condition, by good maker.—COLEMAN, Carlow. 1575

WANTED, 150-H.P., 550/600-volt, 3-phase, 50-period, slip-ring Motor, slow speed; also 25-H.P. 500/600-volt, 3-phase, 50-period, squirrel-cage Motor, speed 580 R.P.M.—Price and particulars to 1566, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, 70-KW. Generator, 250 or 500 volts.—MARTINS, 320, Witton Road, Birmingham. 1531

WANTED, 300-H.P. or more Suction Gas or Diesel Engine, direct coupled to 480-v. continuous-current Dynamo and Switchgear.—GIRLING, Maldon. 6681

MISCELLANEOUS.

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LONDON Firm of Electrical Engineers can undertake a limited number of Repairs to small D.C. Motors up to 1 H.P. Prompt attention for Munition work, &c.—1511, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

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NOTICE.

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For Motormen, Inspectors, and Depôt Workers.

By W. A. AGNEW.

CONTENTS: The Electric Circuit—Electric Tramways—Electric Tramcars—Controllers—Brakes—On the Road—Faults and Breakdowns—Index.

London: H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, E.C.

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SUGGESTIONS FOR DEALING WITH APPARENT DEATH FROM ELECTRIC SHOCK.

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Some thousands of the ELECTRICAL REVIEW'S "Suggestions" are in use in electricity works, also in manufactories and works where electricity is employed. Largely adopted by Mining Installation Contractors. Well spoken of by eminent Central Station Authorities.

THE HOME OFFICE REGULATIONS

For the Installation and Use of Electricity in Factories, &c., now read as follows:

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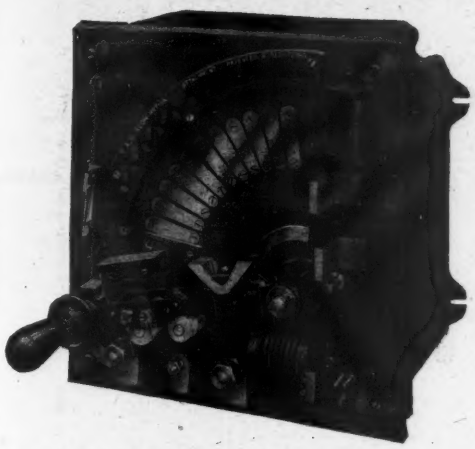

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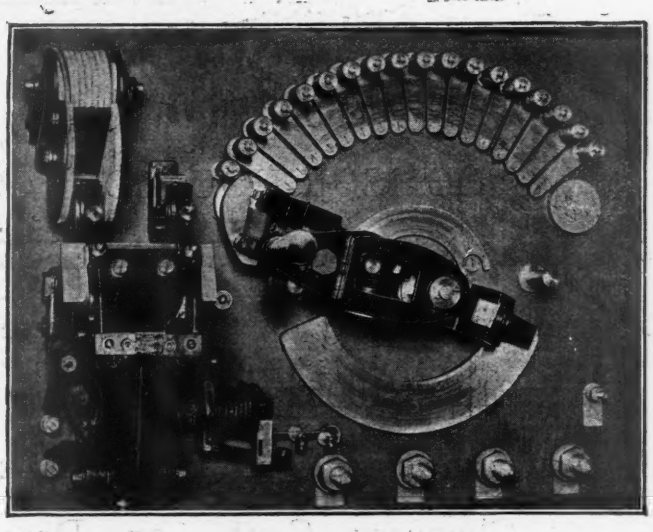

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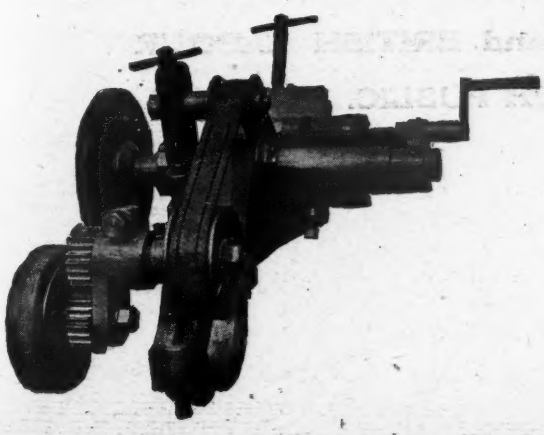

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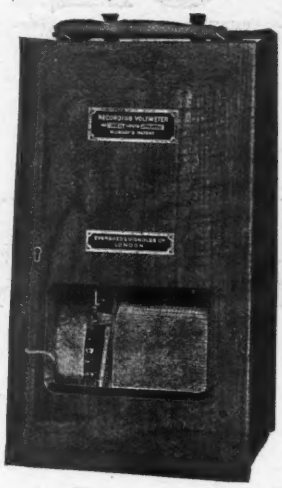

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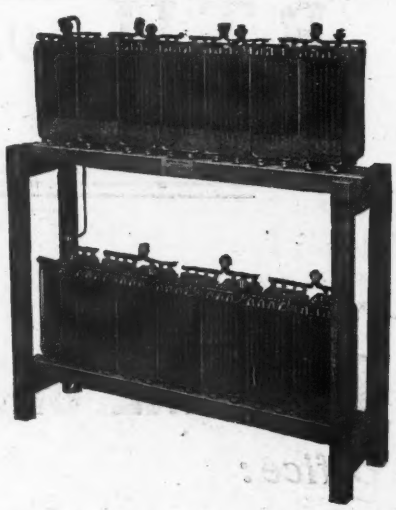

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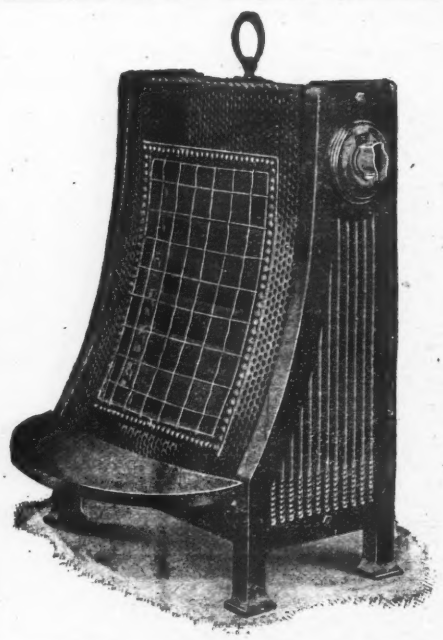

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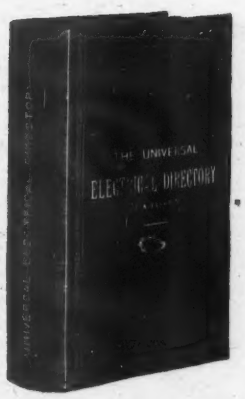

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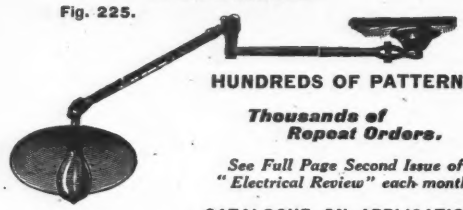
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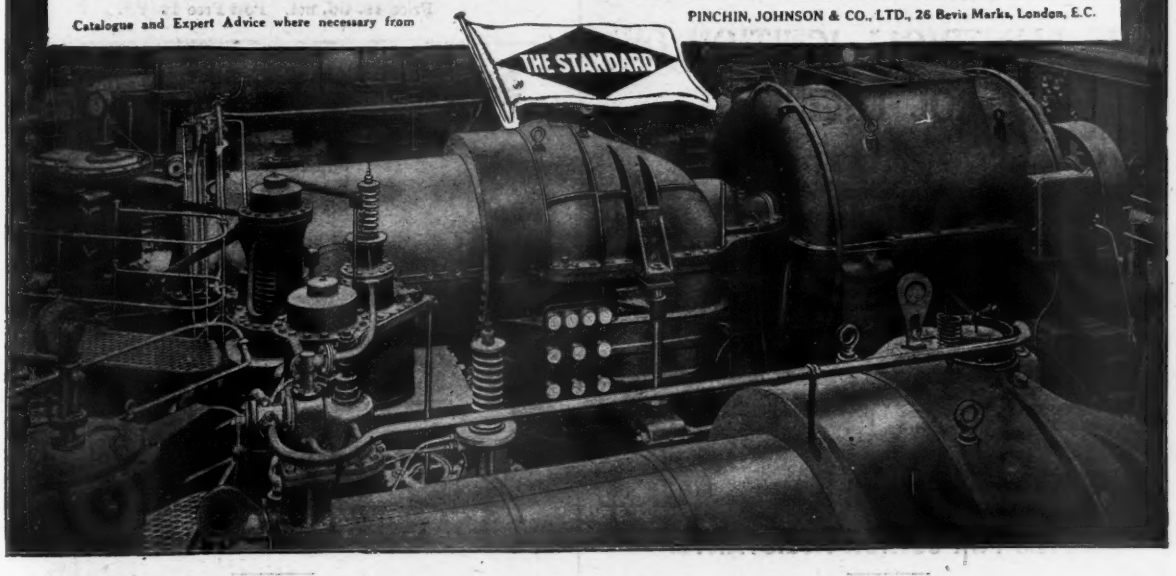

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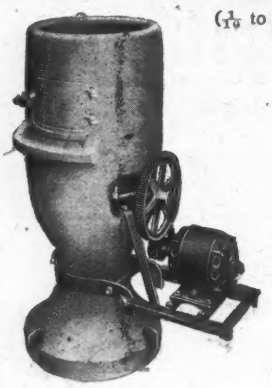

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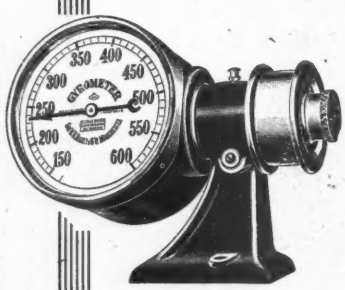

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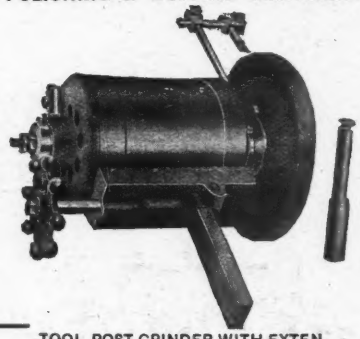

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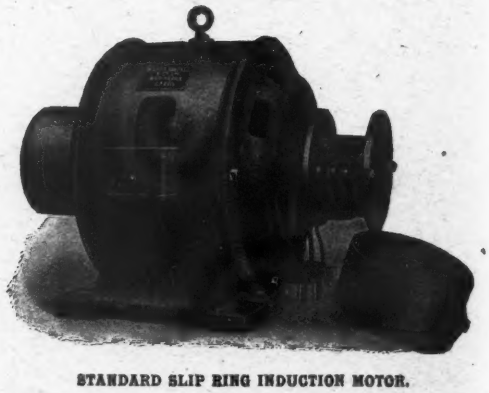

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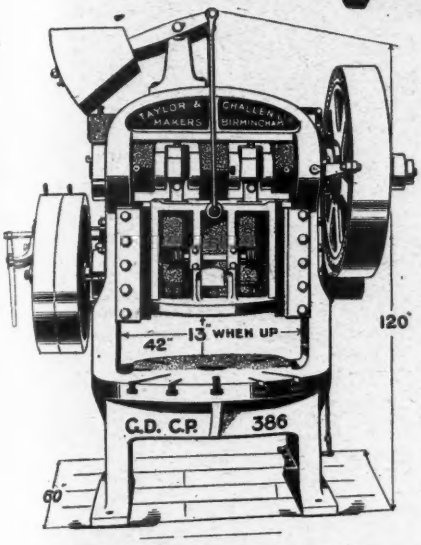

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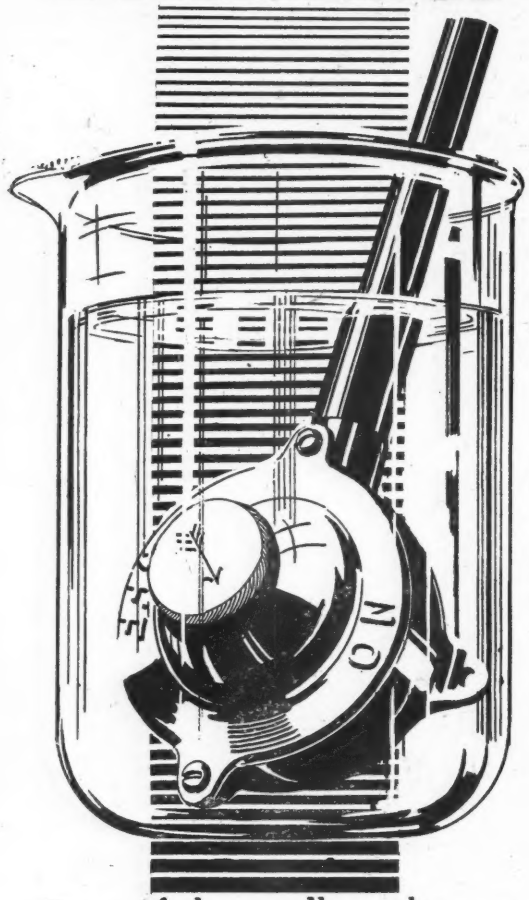

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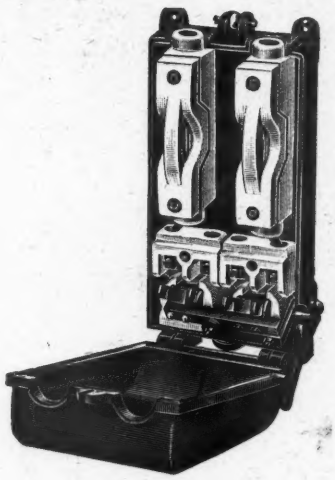

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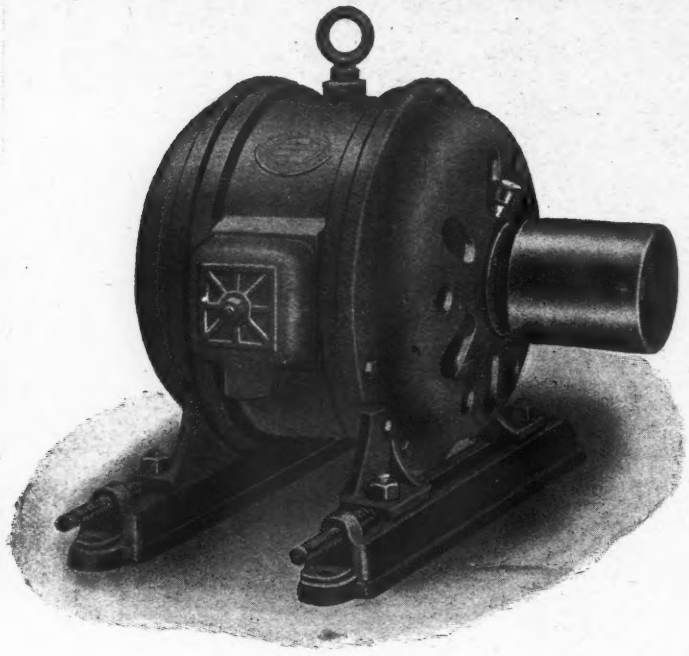

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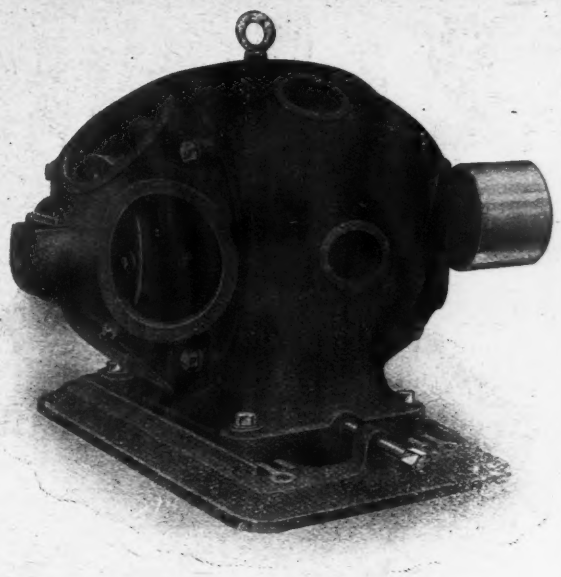

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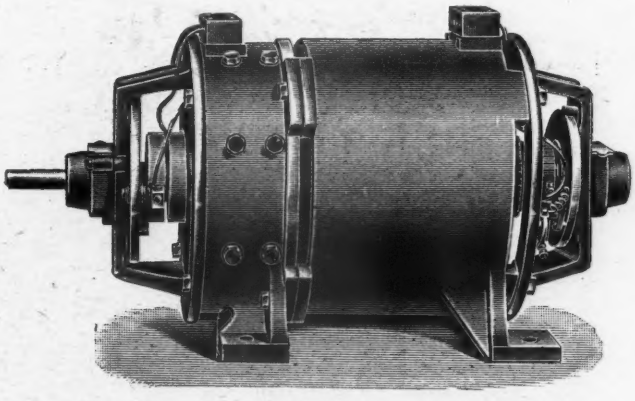

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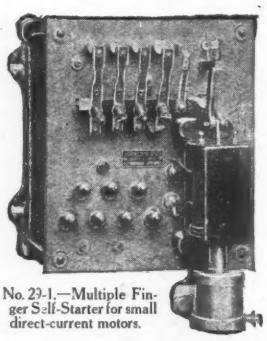
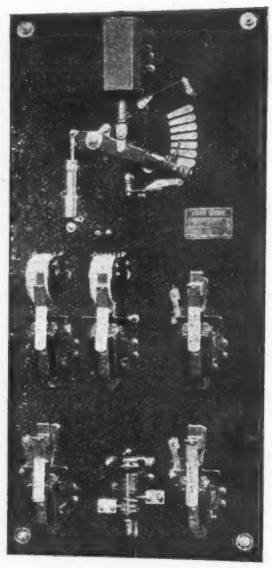
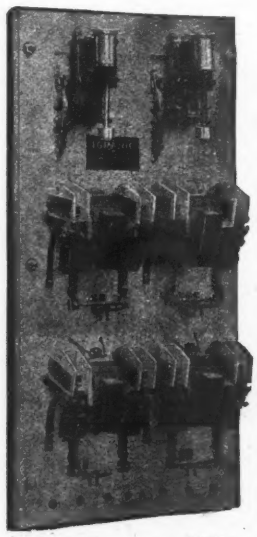


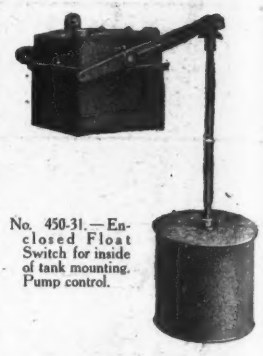
No. 29-1.—Multiple Finger Self-Starter for small direct-current motors.



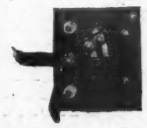
No. 30B.—Solenoid operated Multiple Clapper Starting Panel for large direct-current motors



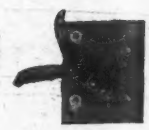
No. 34.—Transformer type Multiple Clapper Starter for squirrel-cage alternating-current Motors.



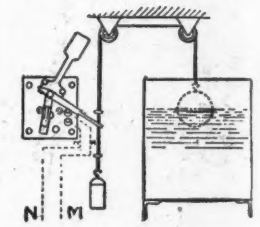
No. 450-31.—Enclosed Float Switch for inside of tank mounting. Pump control.



No. 450-9.—Upper Tappet Limit Switch. Hydraulic Accumulator Control.

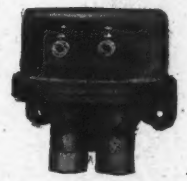


No. 450-10.—Lower Tappet Limit Switch. Hydraulic Accumulator Control.



No. 450-39.—Diagram showing method of mounting open-type Float Switch. Pump control.

No. 450-47.—Single-pole Adjustable Diaphragm Pressure Regulator. Compressor control.



No. 450-51.—Magnetically operated Unloading Valve. Compressor control

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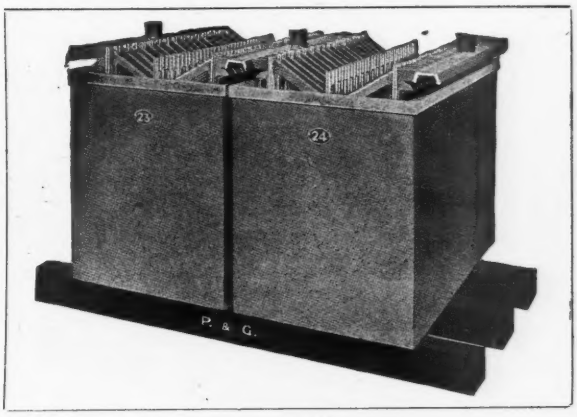

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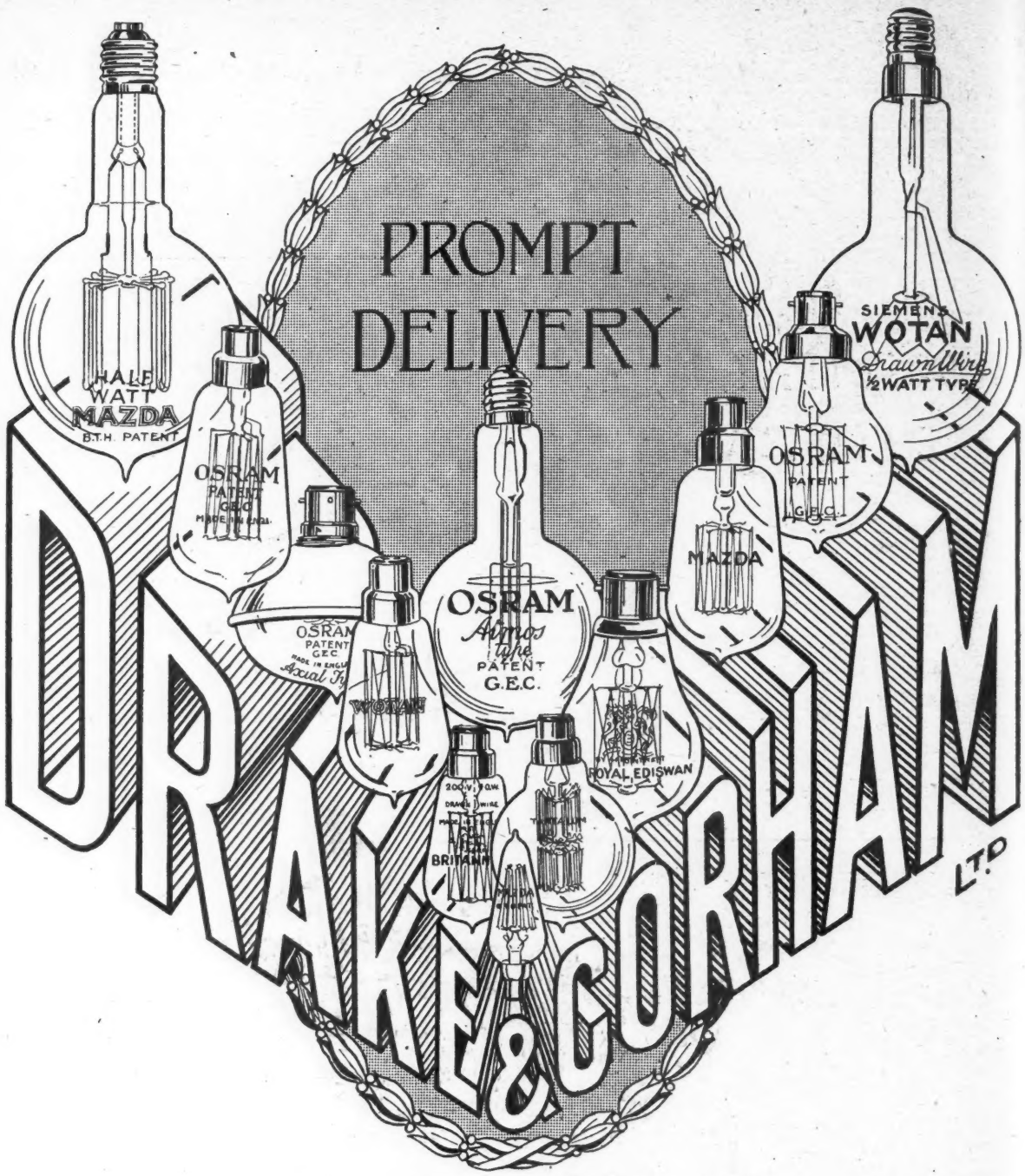

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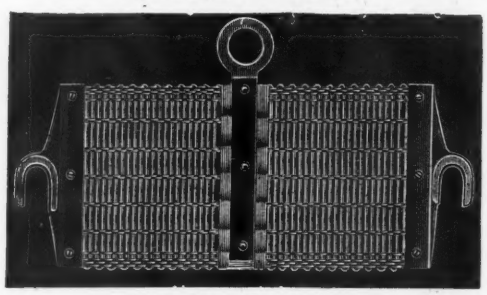
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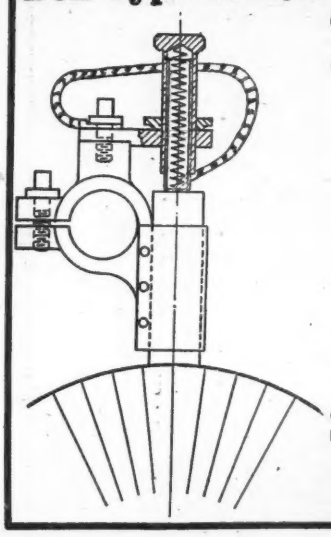

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(Continued on page xxviii.)

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Reliance Engraving Co., Ltd.

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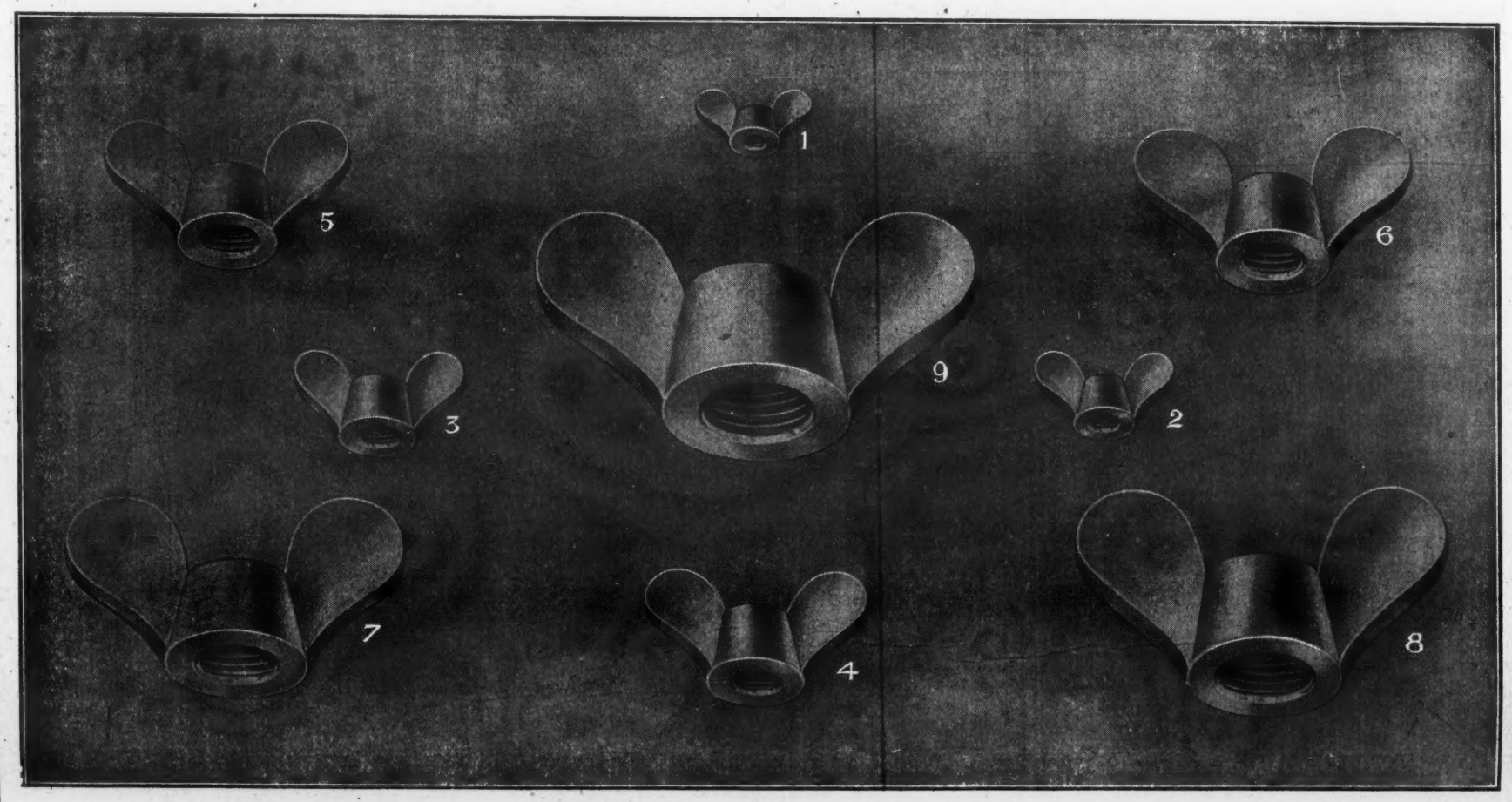

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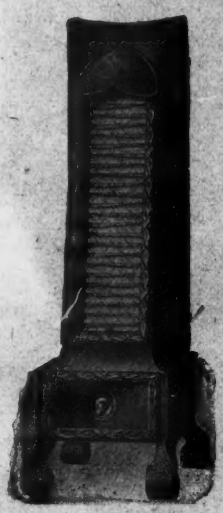

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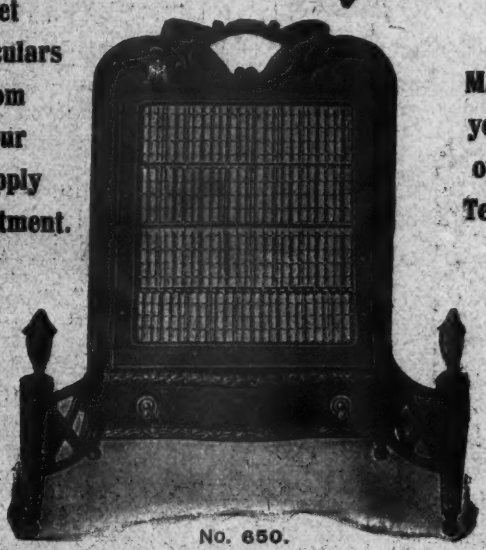

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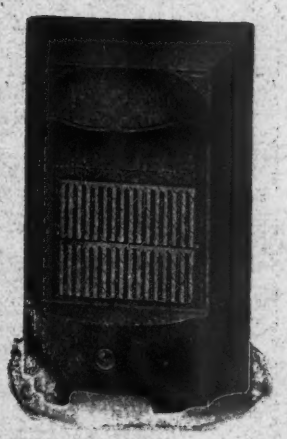

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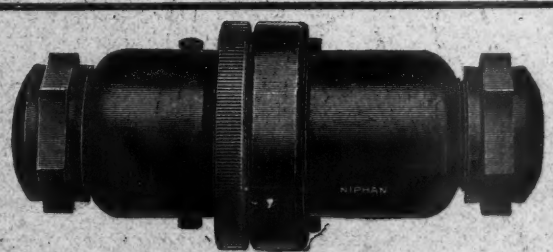

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